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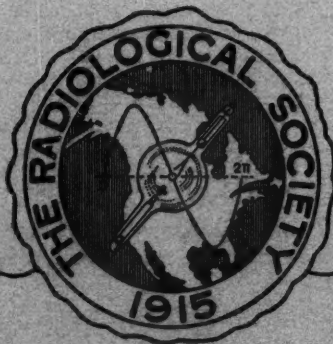
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# RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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JANUARY, 1926

Vol. VI

Number 1

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## THE ORAL ADMINISTRATION OF SODIUM TETRAIODOPHENOLPHTHALEIN FOR CHOLECYSTOGRAPHY<sup>1</sup>

By JULIUS BRAMS, M.D., Assistant Roentgenologist, University of Illinois Research and Educational Hospital, CHICAGO; KARL A. MEYER, M.D., Professor of Surgery, University of Illinois, Attending Surgeon, Cook County Hospital, CHICAGO, and WILLIAM A. BRAMS, M.D., Adjunct Attending Physician, Michael Reese Hospital, CHICAGO

FOR many years it has been the aim of clinicians and roentgenologists to develop some means of visualizing the gall bladder. Many different forms of technic have been suggested and tried with varying degrees of success. The descriptions of what constituted the normal and the abnormal differed with many investigators. Even the question of the radiability of gallstones has been much discussed, some observers claiming the ability to demonstrate 90 per cent of all stones, while the less optimistic ones insist that only about 30 per cent can be visualized. Yet, in spite of all this irregularity of opinion, many important and generally accepted facts relating to the roentgen diagnosis of gall-bladder disease have been established, viz., the demonstration of a certain percentage of stones, the visualization of the gall bladder in cases where that organ is thickened (presumably as a result of disease), the demonstration of the so-called gall-bladder seat on the duodenum, etc. However, the most important advance in this particular phase of gall-bladder diagnosis was made by Graham and Cole (3) when they introduced their method for the visualization of this organ.

It is interesting to review the advances that have been made in the short period of time since the publication of their original paper on this subject. In their preliminary report, Graham and Cole (3) described very briefly the ideas which led to the discovery of a halogen derivative of a drug capable of being excreted entirely in the bile. Beginning first with the calcium salt of tetrabromphenolphthalein they soon abandoned its use for the less toxic sodium salt of the same dye. In their second publication (2), the same authors reported a series of 55 cases in which the dye was used intravenously with a high degree of success. Certain reactions were encountered and detailed precautions regarding the preparation of the patient and the administration of the drug were described. In a third publication (4), a few months later, the originators of this test had collected sufficient data to establish certain important points which are well worth enumerating. In brief, these are that the liver function must be good enough to excrete the dye into the bile; the cystic duct must be open to permit the entrance of bile, and, finally, the concentrating function of the gall bladder must be good enough to produce sufficient concentration of the excreted dye to cast a shadow on the film. Soon after these early reports Carman and Counsellor (1) report-

<sup>1</sup> From the Cook County Hospital and the University of Illinois Research and Educational Hospital, Chicago. Read before the West Side Branch of the Chicago Medical Society, October 15, 1925. Received for publication October 8, 1925.

ed their results following the use of sodium tetrabromphenolphthalein intravenously in 178 cases and concluded that the test was satisfactory in selected cases but necessitated an elaborate technic and was followed

salts is about the same, the much smaller dose of the tetraiodo salt necessary to produce a good cholecystogram gives it a wide margin of safety and makes it the drug of choice.

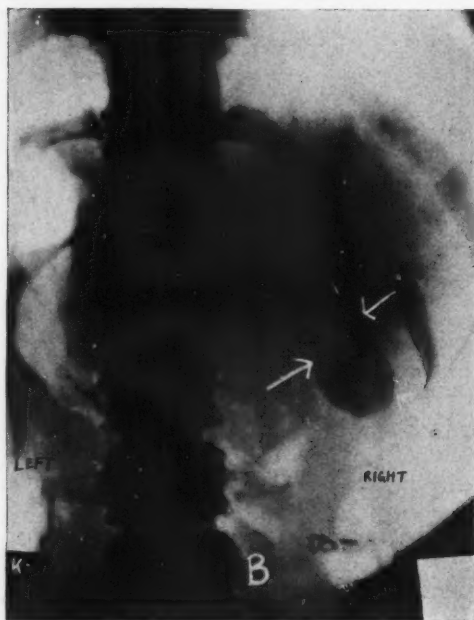


Fig. 1. Normal gall bladder 12 hours after ingestion of last pills.

by more or less severe reactions in a high percentage of cases. Meanwhile, Graham, Cole and Copher (6) were working to develop a less toxic drug and a simpler technic for the administration of it, but were unable to improve upon their original technic. Whitaker and Milliken (14), working along the same line, made a comparative study of sodium tetrabromphenolphthalein and sodium tetraiodophenolphthalein and came to the following conclusions: The ratio of the opacity of the tetrabrom salt to the tetraiodo salt is approximately one to two; giving the lethal dose and examining for gall-bladder shadows in dogs, it was found that only 19 per cent of the tetrabrom dogs cast a shadow against 81 per cent of the tetraiodo dogs. Since the comparative toxicity of the two



Fig. 2. Normal thumb-shaped gall bladder.

Menees and Robinson (8) were the first to successfully obtain cholecystograms following the oral administration of sodium tetrabromphenolphthalein. In the cases of 32 individuals to whom the dye was given, no severe reactions were seen, and the authors concluded that the oral method gives the patient less discomfort, is less time-consuming, is considerably safer, and obviates the danger of local trauma. The chief disadvantage seemed to be the fact that a considerable number of patients were not able to retain the dye. Another worker, namely, Palefski (11), administered this dye orally with relatively good results. In an attempt to avoid the untoward symptoms produced when the drug was given orally, S. Weiss (13) administered the drug by the duodenal tube and per rectum. Stewart (12) also reported

giving the drug by the duodenal tube, and concluded that the technic would be solved when some pharmaceutical preparation of the tetraiodo compound was discovered that would pass safely through the stomach

been along two distinct lines, namely, the manufacture of a non-toxic form of the drug and the simplification of the technic for the administration of it. To both the roentgenologist and the clinician, this test

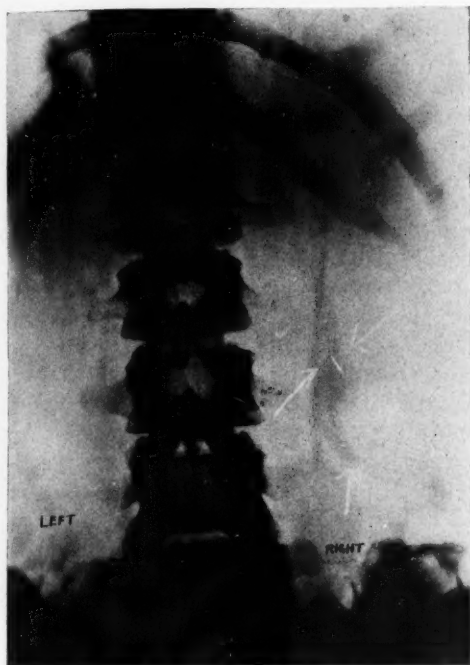


Fig. 3. Normal pyriform-shaped gall bladder 12 hours after ingestion of last pills.

and be absorbed after it reached the jejunum. Just a few weeks later Whitaker, Milliken and Vogt (15) described the oral administration of a preparation which seemed to fulfill the above requirements. The dye was administered in pills coated with stearic acid to sixty-six subjects. Cholecystograms were obtained in 93 per cent of the cases and practically no untoward effects were noted. Other workers, including Menees and Robinson (9), Oakman (10), and, finally, Graham, Cole, Moore, and Copher (7) have since then reported very favorable results following the use of the tetraiodo compound in specially prepared form.

The gradual development of cholecystography as outlined above has obviously



Fig. 4. Same case as Figure 3 two hours after ingestion of meal rich in fats, showing change in size, shape and position.

is extremely important. It is common knowledge that the roentgenologic diagnosis of a pathologic gall bladder, except in cases where stones were demonstrable, has always been a difficult task. Complicated and costly technics, oftentimes assisted by a more or less vivid imagination, have made the percentage of diagnoses higher in some clinics, but generally speaking, the roentgenologic demonstration of the pathologic gall bladder has been unsatisfactory. With the introduction of cholecystography an improvement was made, comparable to the introduction of the opaque meal in gastro-intestinal examinations, but, as indicated above, many serious objections to the original technic were to be overcome. Undoubtedly many workers who gave the in-

travenous method an early trial met with unfavorable results and have formed more or less biased opinions. At the Cook County Hospital a few cases were tried; good cholecystograms were obtained, but

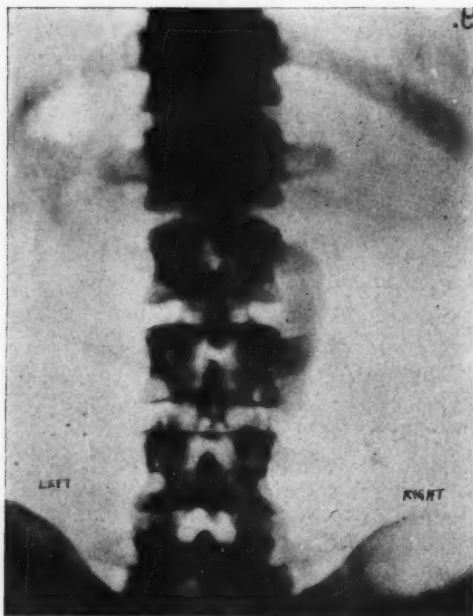


Fig. 5. Carcinoma of the pancreas pulling gall bladder to left.

more or less severe reactions caused the test to be abandoned. At another large hospital where the intravenous method was used very discouraging reactions were obtained and the further use of cholecystography ceased completely. With the introduction of the oral method of administration the entire problem took on a new aspect and in order to help establish its efficacy we decided to examine a number of patients by this method. It is with the idea of reporting our results, which on the whole are very favorable, that we are publishing this report.

The technic used was that introduced by Whitaker, Milliken and Vogt (15), using specially prepared stearic acid coated pills of sodium tetraiodophenolphthalein. A few attempts were made to use other commercially prepared forms of the dye, but

in our hands they proved unsatisfactory. The dose of the drug was about eighty grains divided in four doses and given one-half hour apart beginning at 8 P. M. The patient was instructed to rest on the right side in bed, drink liberal quantities of water, and was denied further food until after the completion of the examination. Water was given *ad libitum*. Catharsis was avoided and the first series of films was taken at 11 o'clock the next morning. After the first examination food containing a high fat content was given and a second series of films taken two hours later. The usual Bucky diaphragm technic with the patient in the prone position, with compression, was used. In all, we examined a hundred cases, of which thirty-four proved to be normal and sixty-six pathologic.

Many interesting points were established regarding the normal gall bladder. An excellent shadow was obtained in practically all the cases. In those few cases in which the shadow was thin it could, however, be definitely said to be distinct, with the exception of one case in which it was definitely absent. On investigation of this case we found that the patient had eaten some fruit following the ingestion of the pills and a short time later vomited—and recognized both the fruit and the pills. The co-operation of the patient is an absolute essential if good results are to be obtained. Without exception we obtained our poorer films from patients who could not or did not co-operate. Several interesting points in connection with the size, shape, and position of the normal gall bladder were brought to our attention. Thus it was found that the position of the normal gall bladder is not only inconstant but varies in practically every individual. A similar variation was found in the size and shape. The assorted variety of shapes could briefly be classified as pyriform, saccular or thumb-shaped. The many different forms suggested a wide range of tonicity of the organ. In many respects this was comparable to the different types of stomach which result from different degrees of tonicity.



Perhaps we are over-enthusiastic in attempting to describe different degrees of gall-bladder tonicity, but an examination of the accompanying figures might easily cause one to conclude that such a thing as

food is taken. In our series every normal gall bladder showed a definite change in size, shape, and density two hours after food was taken. Fundamentally the most important information is obtained from a

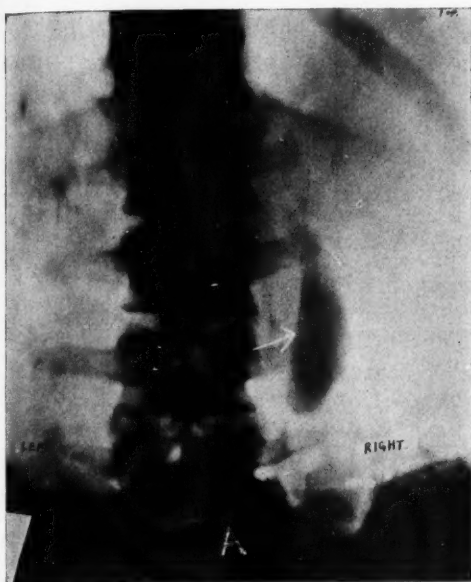


Fig. 6. Case with jaundice and pain in gall-bladder region diagnosed as gallstones clinically, but negative for stone roentgenologically. Operation revealed no gall-bladder pathology and no stones. Symptoms caused by hepatitis of undetermined nature.



Fig. 7. Cholesterol stone in gall bladder showing a negative shadow in an otherwise normally filled gall bladder.

a tonic and an atonic gall bladder does exist.

Three entirely new points in gall-bladder diagnosis are made possible by cholecystography, namely, the character of the shadow, the determination of the elasticity of the gall bladder, and of the concentrating power of this organ. With regard to the first point, practically all of the reports agree that the normal cholecystogram consists of a homogeneous shadow having regular outlines. The concentrating power of the gall bladder should be good enough so that the dye will be present in sufficient quantity to cast a fairly dense shadow. A determination of the elasticity can be made by noting the change in the size and shape of the gall bladder and the diminished density of the shadow several hours after

study of the concentrating power of the gall bladder. Failure in obtaining a good shadow practically always is the result of insufficient concentration of the dye in the gall bladder, and this is practically always the result of some inflammatory process, unless it is known that the liver function is poor or that a stone obstructs the cystic duct.

Of our normal cases, twenty-one were proved at operation and the other thirteen were definitely negative for gall-bladder pathology clinically. In our series of pathologic cases a variety of conditions was encountered. Fifty-four cases of cholecystitis were examined and in none did we obtain a good shadow after the usual technic. Two cases of catarrhal jaundice showed fairly dense shadows. A case of

hydrops of the gall bladder showed a faint shadow of the distended organ. Six cases of cholesterol stone were encountered. In this connection cholecystography is of immense importance. Pure cholesterol stones and even those with a fair amount of calcium are often not recognizable on the film, but against the opaque gall bladder they appear as easily recognizable negative shadows. Three cases of adhesions, one in which the fundus of the gall bladder was drawn down to a pointed projection and another case which was definitely one of carcinoma of the head of the pancreas in which the gall bladder was drawn over to the midline by the neoplasm, were seen. A case of deep jaundice which was diagnosed as cholelithiasis was found to give a normal cholecystogram. At operation this patient was found to have a normal gall bladder and the jaundice was due to a hepatitis of unknown origin.

In our series of cases we encountered a certain percentage of undesirable symptoms. In forty cases the patients felt nauseated, and a few vomited. Not a single patient had any severe or prolonged trouble and on operation no evidence of liver pathology as a result of the procedure could be obtained. No ill effects on the kidney were noted and in general the examination was not more troublesome than a gastro-intestinal examination and far better tolerated than the average pyelogram examination.

#### CONCLUSIONS

1. A series of a hundred cases was examined following the oral administration of sodium tetraiodophenolphthalein.

2. Wide variations in size, shape and position of the normal gall bladder were noted.

3. Many unusual pathological cases were diagnosed by this means, including chronic infections, adhesions, stones, and pathology existing in adjoining organs.

4. Forty-three cases of this series were proven at operation to correspond with the roentgenologic diagnosis, and the remaining fifty-five corroborated the clinical diagnosis. In two surgically proved cases our diagnoses were wrong.

5. All untoward effects have been eliminated by reducing the dose to about fifty grains instead of eighty, as mentioned above.

6. We believe that cholecystography is a definite advance in the diagnosis of gall-bladder disease, and that the method at present is practical and should be carried out routinely.

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# TOXIC GOITER: ITS TREATMENT BY MEANS OF RADIUM AND THE ROENTGEN RAYS: RESULTS CONTROLLED WITH BASAL METABOLISM TESTS<sup>1</sup>

By J. THOMPSON STEVENS, M.D., MONTCLAIR, N. J.

**T**OXIC goiter is a disease or condition frequently called exophthalmic goiter, hyperthyroidism, Graves' disease, and Basedow's disease; because of the symptoms presented by a patient so afflicted, it seems to me that hyperthyroidism and toxic goiter are the more suitable terms. In presenting this subject for your consideration, I wish to make no apology for advising radiation therapy. The clinical results, together with the findings obtained in the laboratory by means of metabolism tests clearly show that in radium and the roentgen rays we have a remedy for toxic goiter which is nearly a perfect specific.

## CLINICAL PATHOLOGY

Toxic goiter is due to an increase in numbers of normally acting cells (hyperplasia) of the thyroid gland. In cases characterized by hyperplasia there is a tumor at the site of the thyroid gland. The tumor may be visible upon direct inspection or it may grow downward into the mediastinum, where it can be demonstrated by means of a roentgen study of the mediastinum. Hyperthyroidism is also caused by thyroid cells which are normal in numbers but which are hyper-active. In such a case no tumor is visible or demonstrable. In some cases there is only a hard nodule in one lobe of the thyroid or rarely in the isthmus, and, in the presence of toxicity, it is called toxic adenoma.

## ETIOLOGY

Toxic goiter is more common in women than in men. Of 200 cases, Eshner reports 161 women and 39 men, and, although it is present at both extremes of life, it is more frequent during adult life. There

appears to be an hereditary influence (noted in two of my own cases), and several of a family may suffer with the disease. Occasionally there is a history of an injury just prior to the onset of symptoms.

Emotional disturbance, worry, severe acute disease, and great mental or physical strain are common exciting causes of toxic goiter. The disease may occur secondary to simple goiter.

## SYMPTOMS

The onset of the characteristic symptoms is generally slow but occasionally is sudden.

In acute toxic goiter the symptoms are excessively rapid action of the heart, vomiting, diarrhea, and marked exophthalmos, sometimes with cerebral symptoms. In cases where there is a history of rapid loss in weight, the condition of the thyroid should be carefully determined.

In chronic toxic goiter increased heart action or tachycardia is almost always the first symptom to appear and, not infrequently, it is present for a considerable period of time before the other characteristic symptoms of the disease appear. In many cases there is a tumor at the site of the thyroid which gradually increases in size and exophthalmos, and always some time during the course of the disease there is tremor. Upon unusual excitement or exertion the heart action increases, the action becoming violent and irregular. Palpitation and dyspnea are disturbing symptoms. In a case treated in 1924 the only symptoms of the disease present were tachycardia and diarrhea. The basal metabolic rate was moderately increased, therefore the diagnosis of hyperthyroidism was in order. Under radiation therapy only, the patient was perfectly relieved of

<sup>1</sup>From the J. Thompson Stevens Clinic for Radiation Therapy and Electrothermic Coagulation. Read before the Radiological Society of North America, at Atlantic City, May, 1925.

both symptoms and the metabolic rate returned to normal.

Physical examination of a patient suffering with toxic goiter shows an individual who appears to be in a state of tension; often the rapidly beating heart can be seen pounding away within the chest, the pulsating arteries and, occasionally, pulsating veins can be clearly seen. Exophthalmos, or protrusion of the eyeballs, is usually present. On closing the eyes a rim of white is visible above and below the cornea; this and Graefe's sign, immobility of the upper lid when the eye is turned downward, are two symptoms of great diagnostic importance. Thyroid enlargement may either accompany or follow the exophthalmos, and is due to the great dilatation of the vessels, particularly of the arteries. The enlargement of the gland may be general or localized to one portion. The gland may pulsate; palpation may reveal a thrill, and often there is tenderness which, to me, means an associated thyroiditis. Muscular tremors, neurasthenia, and various mental disturbances are common findings. The temperature may at intervals be elevated and may be associated with profuse sweatings. Pigmentation of the skin is sometimes present; I recall one case of toxic goiter being diagnosed as Addison's disease. Scleroderma, urticaria, pruritus and localized edema may be present.

The general symptoms are muscular weakness, anemia, emaciation, etc. Leukopenia, the neutrophils being much reduced, the lymphocytes being twice the normal number, is the rule. Vomiting and purging may be present. In some cases there are hemorrhages from the nose, stomach, lungs, etc., but more commonly there are albuminuria and glycosuria. Very rarely myxedema is associated.

The diagnosis of toxic goiter is in order when any or all of the above symptoms are present, together with a positive basal metabolism test. Basal metabolism tests not only point the way to correct diagnoses in obscure cases, but also show up the value of the various methods of treatment from

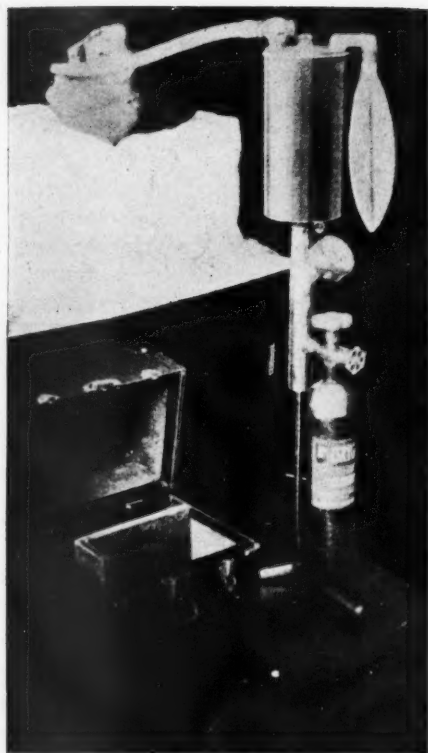
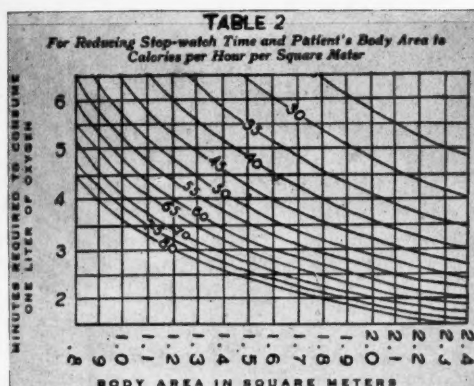
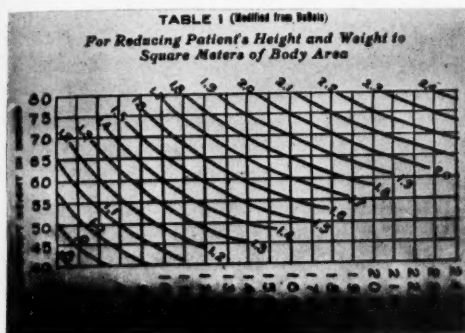


Fig. 1. Photograph showing the apparatus for taking the metabolic rate, the positions of its various parts in their relations to each other, to the patient, and to the operator.

the standpoint of results obtained. Once the diagnosis of toxic goiter is established and the basal metabolic rate determined, check on the progress of the case can be kept by frequent tests; these will show by a gradual reduction of the metabolic rate that the treatment is efficient. The test will also show when treatment can be stopped, at the same time permitting us to know that a normal state of affairs is present. In other words, basal metabolic tests show when to treat for toxic goiter; also, when to stop. In figures, the apparatus gives us the diagnosis, the progress of the case, and, if treatment is efficient, it shows just when to stop. There can be no argument against these figures; they indicate a method of treatment that will establish normality, not too great or too little destruction of the



gland, but just the exact amount of destruction. Basal metabolic studies are of great importance to the radiotherapist for they clearly show that no method of treatment can exceed this; in fact, in many cases there is no equal.

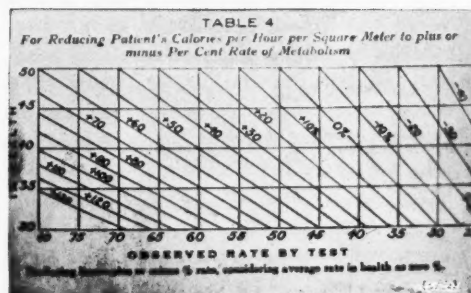


#### TECHNIC OF THE BASAL METABOLIC TEST

The technic of the basal metabolic estimation can best be described by taking an imaginary case, say, a male: age 35; height 65 inches, nude weight 155 pounds; averaged 3.1 minutes to consume one liter of oxygen. Table No. 1 shows his height line intersects his weight line in a point between the oblique lines 1.7 and 1.8, say, at 1.79. This 1.79 is his body area in square meters. Table No. 2 shows this body area line, 1.79, intersects his 3.1 minute line in a point between 50 and 55, say, 52. This 52 represents his "observed rate" of metabolism in calories per hour per

**TABLE 3**  
AVERAGE RATES OF PERSONS IN HEALTH IN CALORIES PER HOUR PER SQUARE METER BODY AREA  
FROM AUB & DU BOIS

AGE	MALES	FEMALES
8 8	58.0	58.0
9 10	54.0	54.0
10 12	52.0	50.0
12 14	50.0	46.0
14 16	46.0	43.0
16 18	43.0	40.0
18 20	41.0	38.0
20 30	39.5	37.5
30 40	38.5	36.5
40 50	38.5	36.0
50 60	37.5	35.0
60 70	36.5	34.0
70 80	35.5	33.0



square meter of body area. Table No. 3 shows the "average rate" for persons of his age and sex to be 39.5 calories per hour per square meter of body area. Table No. 4 shows this 39.5 "average rate" line intersects his 52 "observed rate" line in a point between plus 30 per cent and plus 40 per cent, say, plus 31 per cent. His rate is, then, 31 per cent above the average for his age and sex, or plus 31 per cent rate of metabolism. Normal readings are between plus or minus 10 per cent.

#### INDICATIONS FOR RADIATION THERAPY

Those of us who have had considerable experience in the management of hyperthyroidism or toxic goiter appreciate the fact that the diagnosis of this malady indicates at least a trial with radiation therapy, with one or both of the physical agents, radium

and roentgen rays. If the operator be competent, only very rarely will anything else be necessary other than the indicated medical treatment. Associated medical measures are very important, no matter what form of specific treatment is prescribed. Radiation therapy is the only method of radical treatment that can be safely carried out in cases showing a high basal metabolic rate or in those with a low metabolic rate which is rapidly rising.

#### CONTRA-INDICATIONS FOR RADIATION THERAPY

To me, a large tumor which is showing *distinct signs of pressure* is indication for surgical removal. This will promptly relieve the pressure symptoms and, if too little of the gland is removed to produce normality from the symptomatic and basal metabolic rate standpoints, radiation therapy can be expected to perfect conditions if used post-operatively. On the other hand, pre-operative radiation will reduce a high basal metabolic rate, thus making operation safer.

Someone has stated that radiation therapy is followed by dense adhesions which increase the difficulty of surgical removal should this prove necessary. Therefore, I wrote to Dr. George W. Crile, whose position in the world is well established because of his excellent surgical treatment in toxic goiter. His letter follows: "Regarding your inquiry concerning the X-ray therapy in thyroid cases, I have frequently operated upon patients who have had long continued treatment and have noted that these patients, if the treatment has been long enough, may have adhesions which are somewhat difficult to dissect. The ordinary case, however, which has had X-ray treatment, shows very little change as compared with other glands. As you say, it might also be due to thyroiditis. A great many of these cases also have marked hyperplastic glands, and these cases, even without any treatment, have been very difficult to dissect out." Dr. John Rogers, of New York City, recognized the world

over as one of our best thyroid men, in answer to a similar inquiry, says: "I often have these cases X-rayed before and after operation and have never found the operative difficulties increased." To me, the statements of these two authorities are so clear and to the point regarding this question that further discussion is unnecessary.

Another objection to the irradiation of toxic goiter, raised by some, is the danger of producing the opposite disease—hypothyroidism. Of course, you and I know that there is no danger of such an accident. No normal thyroid tissue can be destroyed by any such dosage as is employed in the treatment of hyperthyroidism. How many cases of cancer in this locality have we treated, the dosage received by the thyroid being several times the dose ever employed in the treatment of toxic goiter? Yet, to my knowledge, there is not a single report of hypothyroidism ever having been produced by such treatment. In my own practice, careful check has been kept on several patients receiving cancer treatment in this region, where the thyroid gland was completely irradiated by several times the dosage ever used in the treatment of toxic goiter, and not one case of hypothyroidism or even slightly lowered basal metabolic rate has occurred to date. If anyone here has ever seen a case of hypothyroidism produced by radiation therapy, I shall appreciate it very much if he will record that case here in the discussion of this paper.

Concluding the discussion on the indications and contra-indications for radiation therapy in toxic goiter, it appears that those patients who present severe pressure symptoms from large tumors, those who ought to have quick relief, are the cases for surgery. Later, if toxicity still exists, radiation therapy can be added to perfect conditions. Also, those who fail to get relief after properly applied radiation therapy should be referred for surgical treatment.

#### TECHNIC FOR RADIUM TREATMENT

Radium is used in the case of those patients who are unable to leave their beds

because of the severe toxicity. It consists of using tubes or needles of ten milligrams in sufficient numbers to cover the tumor. They are applied in the form of a pack filtered by the needle wall plus one millimeter of brass at a distance of two centimeters. The distance between tubes is one centimeter. The time duration is up to sixteen hours, as indicated by the individual patient. So soon as improvement warrants it, the patient is brought to the clinic and treated with the roentgen rays, because the roentgen treatment can be executed quicker. Occasionally, in refractory cases, a change from the roentgen rays to radium will produce a happy result.

#### TECHNIC FOR ROENTGEN TREATMENT

It is, of course, impossible for me to outline a technic of roentgen therapy for toxic goiter that can be blindly followed by anyone who happens to own an apparatus for the production of roentgen rays. To properly treat such a case requires not only knowledge of the disease in question, but also good judgment and detailed knowledge of the physics of radiation therapy, which, of course, come only through a thorough grounding in the subject and much practice. However, in general, this is the plan for roentgen treatment: A vertical line is drawn through the center of the isthmus of the thyroid and extended downward through the center of the sternum to the lower border of the thymus region. Then a horizontal line is drawn above the thyroid gland, extending outward to the distal edges of the thyroid gland. Here two more vertical lines are drawn, one at the right and one at the left. The rays are then applied in such a way that the central beam passes through the center of each lobe of the thyroid, and downward and inward through the thymus region. Then the patient is turned into the prone position and the rays are applied through two posterior ports, exactly as was done with the patient in the supine position. The factors are 4 ma., 140,000 volts, 30 cm. distance, and

6 mm. Al. filter. In a very toxic case this treatment, if applied in proper dosage, can be repeated in two weeks, otherwise an interval of four weeks is generally allowed. Thereafter treatment is repeated, allowing increasing intervals of time between treatments, or as indicated by the clinical condition of the patient plus basal metabolic rate tests. Associated medical treatment should be encouraged. Careful search should be instituted throughout the body for chronic abscesses at the time of the initial treatment. Unless such foci are located and eradicated, results are apt to be slow, no matter what treatment is given.

#### RESULTS OF TREATMENT

The recoveries in cases of toxic goiter properly treated by means of radiation therapy are without question not less than twice the number of failures. This is the reason why each year more patients are seeking the treatment. From Copenhagen, Fischer reports a series of 490 patients treated. Also, there are the excellent reports of Pfahler, Christie, Groover, and Merritt; Grier and Boggs. Means and Holmes report about 66 per cent recoveries under radiation therapy. Judging from my own experience, I feel sure that the curability of toxic goiter is considerably higher. Several of my failures, I feel, have been due entirely to the lack of proper co-operation. Not enough toxic adenomas have been treated in my clinic to determine their curability; however, the few treated have been highly resistant. Thus far about 75 per cent have shown definite improvement or recovery.

#### REPORTS OF CASES

Case 1. Mrs. G. H., referred by Dr. Benedict Willis; age 32, weight 170 pounds. Ill two years with extreme nervousness, high blood pressure, tremor, moderate enlargement of thyroid, exophthalmos, etc. The pulse was 126, the basal metabolic rate plus 70 per cent. Ten series of treatments were followed by a disap-

pearance of all of the above symptoms save the exophthalmos, which is considerably lessened, a pulse of 84 and a metabolic rate of plus 10 per cent.

Case 2. Miss B. W., referred by Dr. W. E. Doremus; age 25, weight 110 pounds. Ill one and one-half years with nausea, weakness, nervousness, palpitation, tremors, slight enlargement of thyroid, insomnia, and loss of weight. The basal metabolic rate was plus 85 per cent. In two sittings the thyroid arteries were ligated and, later, thyroidectomy was attempted, but was given up when patient collapsed. Four series of treatments were followed by a return to normal in all respects and a metabolism test of 0. Basal metabolic estimations were made by Dr. Doremus. This case illustrates what can often be accomplished by combined methods of treatment.

Case 3. Miss J. S., referred by Dr. W. G. Herman and Dr. L. Lewis Leonard; age 34. Ill one year with general malaise, nervousness, excitability, palpitation, tremors, sensation of tension, exophthalmos, loss in weight, and slight enlargement of thyroid. Pulse 120, weight  $96\frac{1}{2}$  pounds, basal metabolic rate plus 80 per cent. Seven series of treatments were followed by a disappearance of all symptoms save a slight residual exophthalmos, and a basal metabolic rate of plus 10 per cent.

Case 4. Capt. H. M. C., referred by Dr. C. D. Cropsey; age 39, weight 208 pounds. Ill about eight months, with loss of weight, ashen color, weakness, tiredness, nervousness, palpitation, and for the past three months a gradual enlargement of the thyroid. Patient was carried into the clinic, pulse 114 after a rest on treatment table, and a basal metabolic rate of plus 82 per cent. Eight series of treatments were followed by a disappearance of all symptoms, a metabolic rate of minus 2, and the patient returned to his work. Basal metabolic estimations were made by Dr. Wright Mac-Millan.

Case 5. Mrs. M. F. C., referred by Dr. C. W. Crankshaw; age 54. Ill about two

years with choking attacks, nervousness, bitter taste, irritability, general malaise, constipation, was easily frightened, had tremors of entire body, anorexia, and weakness. The weight was  $107\frac{1}{2}$ , the pulse 90, and the basal metabolic rate plus 30 per cent. Three series of treatments resulted in the gradual disappearance of the above symptoms and a return to 0 metabolic rate. Then, four months later, the symptoms began to reappear and the basal metabolic rate was again plus 30 per cent. Reradiation was followed by a gradual increase in all symptoms of toxicity, which eventually disappeared under medical measures. During the recurrence Dr. Edward Ill has been in charge of the case from the surgical standpoint, and in consultation he decided that there were no indications for surgery and expressed himself as feeling sure that radiation therapy had done all that was necessary. Dr. John Rogers is advising from the medical standpoint. This case is too recent to be included in the statistics of this paper. No one knows what the outcome of this case will be, because the patient is still under observation. Personally, I have never seen another case of recurrence, once the metabolic rate has returned to 0, and this case is reported here with the hope that others will be able to report that they have never seen any, or to record similar cases.

In a series of 100 consecutive cases there is one death from toxic goiter to report. This was a case of Dr. Harry Briody's, who died about twelve hours after I first saw him, while undergoing his initial radium treatment. The death was in no way due to the treatment but had been expected for days before. All realized that the patient would probably die of the goiter, no matter what was done.

Three patients treated by me have been operated on. In two of the cases, I feel sure that had they been a little more patient an excellent result would have been obtained by means of radiation therapy. The other case presented a large tumor and grave pressure symptoms which, up to the



time of operation, had not responded to irradiation. The best surgical result was realized in this case, the surgeon reporting to me that at the time of his last inspection of the case the patient still presented about 10 per cent of his symptoms. None of these three cases has had a basal metabolic estimation since operation and all three surgeons reported their patients as still presenting evidence of toxicity, though to a greatly lessened degree. I regret that post-operative irradiation was not advised in each case; this might have brought to each a perfect result.

Twenty-one cases did not complete treatment. Some discontinued treatment too early to know whether or not radiation therapy was of value. Some discontinued treatment upon the advice of their friends and neighbors, who had never heard of such treatment for toxic goiter. These cases, together with the four reported above, give twenty-five failures in one hundred consecutive cases treated.

#### CONCLUSIONS

1. The terminology, clinical pathology, etiology, symptoms, technic of basal metabolic estimations, indications and contraindications for radiation therapy in toxic goiter or hyperthyroidism are reviewed.

2. The technic for radium and roentgen treatment, together with the results obtained, are outlined.

3. Radium and the roentgen rays will probably cure from 66 to 75 per cent of cases of toxic goiter. The results are at least equal to those obtained by any other method of treatment.

4. Patients with large tumors, who present symptoms of pressure, ought to be operated on for quick relief. If normality in all respects is not realized, irradiation can be expected to perfect conditions in many instances.

5. Chronic abscesses or foci of infection should be eradicated in each case of toxic goiter, no matter what treatment is advised.

6. Skill and good judgment are absolutely necessary in the application of radium and the roentgen rays; otherwise any good results obtained are apt to be accidental.

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## HYPERTHYROIDISM<sup>1</sup>

By A. E. BARCLAY, M.D., MANCHESTER, ENGLAND

I REGRET that I have nothing new to bring to you in this short note on Hyperthyroidism, but I have been so much struck by the insistence of my surgical colleagues as to the almost universal prevalence of operative procedure and the magical results that are shown to them when they come to visit this country, that I thought it worth bringing to you a paper that deals rather with the clinical than the technical side of the subject. Our experience of hyperthyroidism in England is that the condition is of a comparatively mild type and that the vast majority of the cases are arrested, improved or cured by radiations. Naturally the radiologist who sees such satisfactory results has little patience with his surgical colleagues and other philotomists—if one may coin a word—who want to whip out the thyroid, like the appendix, on the slightest pretext.

In Osler's text-book (1898 edition) we find that 25 per cent of cases of hyperthyroidism run a fatal course. Now, I am perfectly convinced that such a figure as this would be entirely wrong for the cases I see, even if they received no treatment at all. This leads me to think that the type of hyperthyroidism that you see on this side is of a much more malignant nature than that seen in England. Osler's book was written before he came to Oxford, so that his experience is Canadian and American. My impression is further strengthened by the fact that at the Mayo Clinic, before the introduction of lugol, there was a death rate that ran into an appreciable figure among those who were waiting for operation, and, even since its introduction, there are still a number of deaths each year among those that are not quite fit to be operated on at once.

It appears to me, therefore, that in England the disease which we term hyperthyroidism is of a much less malignant type.

one that, in my experience, tends to produce chronic nervous invalids with cardiac weakness rather than fatal results. I, therefore, propose to deal mainly with the clinical picture, lest, in talking of hyperthyroidism, we have a different conception of the disease. With the exception of those rare cases that run a rapid and fatal course, we think of hyperthyroidism as a slowly developing and chronic type of disorder that usually has no well defined onset and which has often been well established for months or even years before the radiologist sees the patient.

The names of several physicians are associated with the symptom complex that is the expression of the over-secretion of the thyroid gland. The condition was first recognized as a clinical entity and described as such by Parry, of Bath, and, if it is to be called by any man's name, it is surely his by right of precedence, for his paper was published in 1786. Graves, of Dublin, did not publish his work on the subject till 1835. Moreover, his name, to the ear of the nervous patient, is unfortunately suggestive, and, if for no other reason, it were best discontinued on this account. Flajani, the Italian physician, wrote his description in 1800. Basedow did not describe the condition till 1840.

The name "exophthalmic goiter" also is unfortunate, for it often conjures up a picture of some sufferer in whom this sign of the disease is a prominent feature. The dread of such a disfigurement is a very real factor in increasing the mental uneasiness, the sense of impending disaster, that is frequently associated with the disease. It is, therefore, advisable, on all accounts, to use the term "hyperthyroidism," both for the sake of the patient and for the sake of descriptiveness.

Although primarily concerned with his special form of treatment, the radiologist sees such a large number of cases that he

<sup>1</sup> Read before the Radiological Society of North America, at Atlantic City, May, 1925.

naturally gains a wide clinical experience of the disease. His treatment of the case is no stereotyped and routine course, and he must be prepared to vary it according to the individual needs, and he must take full responsibility for the treatment he gives. It is for him, and for him only, to prescribe the dose and the period at which it is given. If he is to do this intelligently, he must necessarily take a keen interest in the clinical picture that is changing before his eyes under the mysterious action of radiations that produce such definite results. In England, the radiologist does not, however, undertake the treatment of the case except in so far as his own method of treatment is concerned, the general treatment of the patient and the prescription of drugs being the province of the medical man in charge of the case.

The basis of this paper is an analysis of three hundred consecutive private cases, kindly undertaken by my friend, Dr. F. M. Fellows, who is not and never has been engaged in radiological practice, his only interest being that he is one of the three hundred. The responsibility for the diagnosis of the condition is not ours, but rests on the shoulders of the physicians who referred the cases for treatment, a very large proportion of them having passed through the hands of Professor G. R. Murray.

In the three hundred cases with which this paper deals, no attempt has been made to separate the toxic from the other varieties of this disease. A definite exciting cause, usually mental shock, was recorded in only forty-two instances, but no leading questions were asked in the routine taking of the notes. This number is too small to be of value in this respect. In a large proportion, dental and alveolar sepsis was noted and treated. This, although not part of the radiologist's treatment, is of such importance that we invariably make a radiographic examination of the teeth as a part of the systematic examination.

The sex incidence shows that there were two hundred and sixty females, 86.6 per cent, and forty males, 13.3 per cent.

The age incidence was as follows:

#### 260 FEMALES

Age:	0-10	10-20	20-30	30-40	40-50	50-60	60-70
	1	14	57	78	75	28	7

#### 40 MALES

	1	3	12	19	6
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Thus the commonest age for females is from 30 to 50, while the age for males would appear to be a little later.

There are six instances of hyperthyroidism running in families, two or more in a household having developed the disease. In one case, three sisters out of seven developed hyperthyroidism. Two had died and the third, the only one who came under treatment, is now in perfect health.

Of the cardinal symptoms—goiter, exophthalmos, palpitation and tremor,—the goiter is by no means constant and was present in not more than three-quarters of the cases. Exophthalmos also was noted in about the same proportion, but tachycardia and tremor were practically constant.

The *goiter* was usually general, involving the isthmus, but the degree of hyperthyroidism bore no relation to the size of the thyroid. *Exophthalmos* was in some instances very prominent. *Tachycardia* and palpitation were the most constant symptoms, and the average pulse rate was about one hundred and twenty, but occasionally so rapid that it was uncountable.

The type of the *pulse* at the wrist in this disease is peculiar, exhibiting a slight nervous character or thrill that is quite characteristic. This feature of the pulse seems to clear up as the patient's general condition improves, even though the pulse rate at the time of the examination has not gone down to any extent.

The *tremor* is also a constant and the most noticeable feature in the case. It may be so fine as to be hardly appreciable unless the fingers are observed alongside

some steady object, or so coarse that the patient may be unable to raise a full cup of tea without spilling it. The two types of tremor are often co-existent.

Hyperthyroidism begins insidiously: the patient feels "below par" and lacks energy, and a little later becomes conscious of the heart's action. The pulse rate increases slowly; then comes palpitation on exertion and the pulse takes on a different character. There is a nervous tremor or thrill in it which is difficult to describe but very characteristic. There is a diffuse apex beat and the left ventricle is enlarged. Examined radiographically this enlargement is found to take place backwards rather than outwards in the first instance. It is, therefore, not apparent on physical examination. Under certain fixed radiographic conditions the normal measurement of the displacement of the shadow of the left ventricle is 14 mm. when the X-ray tube is moved 10 cm., but with enlargement of the left ventricle a displacement of twenty-five to thirty mm. is common.

*Nervousness* is an almost invariable symptom but variable in character; it may take the form of lack of confidence—fear of traffic or of heights is often complained of. Irritability of a senseless type is frequent, and marked lack of self-control. Tears are ready to flow even without apparent cause, and a feeling of impending disaster, or of being late for an appointment, is complained of. Mental instability is another feature and from time to time borderline cases of insanity are noted, but in the series under consideration all of these except one recovered mental equilibrium. Sweating is a prominent feature and there is, as a rule, considerable loss of weight and energy.

Patients suffering from hyperthyroidism do not catch cold, and an infection of this nature usually indicates that the treatment is beginning to tell. Neither do they feel the cold, and go lightly clad in winter. Absence of chilblains is another curious feature. Edema of the ankles occurs with some frequency. Diarrhea is common, as

is also loss of hair. The association of diabetes with hyperthyroidism is more than a coincidence. We have an instance where two sisters have both hyperthyroidism and diabetes, and about ten cases in the series in which we know of the two diseases being coincident.

Metabolism is greatly increased, especially in the more acute cases, but my experience of the metabolic rate tests has not given me information of a more accurate nature than that provided by an experienced physician. Machine-made diagnosis does not appeal to me unless I am convinced of its increased accuracy. I personally would always prefer the opinion of a competent physician in the estimation of the severity of this disease.

*Treatment:* "The natural course of the disease is so variable that there is great difficulty in correctly interpreting the effects of treatment. Under similar treatment some improve rapidly, some remain stationary for a long time, others fluctuate or lose ground or die." (Ord and Hector McKenzie, 1897.) "It is necessary to maintain an open-minded attitude toward the therapy of exophthalmic goiter, always recognizing that at present it rests on an empiric basis. Etiology must be established before rational therapy can be employed."<sup>2</sup>

Bearing these warnings in mind we turn to the consideration of X-ray treatment.

Three types of radiation may be used,—radium, high voltage X-rays, and ordinary X-rays of medium wave length.

Radium has the advantage of being portable. High voltage therapy in small doses has given satisfactory results in the cases in which we have used it, but neither better nor worse than those treated on the old lines. The three hundred cases were all treated by ordinary X-rays. The patient is treated lying down, with the head a little raised, the large oval localizer right down to the thyroid, including the whole of one side of the thyroid and the superior mediastinum. The other side is then treated, the

<sup>2</sup> REED, I. M.: Jour. Am. Med. Assn., Dec. 20, 1924.



middle lobe getting the overlapping dose from each side. We use a filter of two or three mm. aluminum, and, lest the aluminum may not be pure, a layer of boiler felt between the localizer and the patient. The tube is at a distance of nine inches from the skin, and we use a six- to seven-inch spark gap, point to point. The dose administered is equal to less than one-third of an erythema on the skin. This can be given twice a week without damage. At the end of two or three weeks we expect to find some improvement, and almost invariably do. The period between doses is then increased to a week and, according to the patient's response to the treatment, we lengthen the intervals between the doses. As recovery progresses the intervals are extended to a fortnight, a month, three and finally six months, but no rule can be laid down, as it depends entirely on the patient's progress. We often go back to more frequent doses if progress is not maintained or if the patient tends to slip back. Our object is to bring about the normal balance of internal secretions with the minimum of risk. When I talk of risk, I do not mean risk to the skin so much as those unknown actions of radiation on the blood which we know are brought about by heavy doses. Perhaps I am ultra-conservative, but I see no real benefit to be gained by more intensive methods, or in attempting to obtain results quickly if we can do it less rapidly without risk.

The number of treatments necessary in each case is variable. The smallest number in which a patient was apparently cured was six. The average number is about twenty, spread over a long period (it may be a year or more), but the patient is usually on the way to recovery after six weeks. X-ray treatment must be persisted with: the results are slow and progress is marked by "ups and downs" which recall the appearance of a typhoid temperature chart.

The first favorable sign is the loss of the nervousness, with a gradually increasing brightness of outlook. Strength begins to return and the patient is able to do a certain

amount more. The heart recovers slowly, a fall in the pulse rate being generally noticeable by the end of the fourth week, and there is a return of self-confidence, for which the patient is very grateful.

As I have already said, progress is not uniform but is marked by "ups and downs," and if the patient tries to do more than she is equal to when one of these slight reverses is present, she may have a bad setback. As a rule, however, the patient quickly recovers from these setbacks, with the application of a few extra treatments.

Goiter and exophthalmos are two features of the case which are variable in their response; sometimes there is complete return to normal. We have no reliable records, but would estimate that the exophthalmos disappears eventually in about 75 per cent or more. Occasionally one eye recovers before the other. Neither the eyes nor the neck are any guide as to the progress of the patient, and quite a number have gone back to full work with prominent eyes and neck.

The treatment is continued long after the patient is back at work and living a normal life. Indeed, so convinced are patients of the good effect that the X-rays have on them that there is sometimes difficulty in getting them to stop coming for treatment.

#### RESULTS OF THREE HUNDRED CONSECUTIVE PRIVATE CASES TREATED DURING THE PAST ELEVEN YEARS

Cured .....	190	63.3%
Improved .....	74	24.6%
Not improved .....	16	5.3%
Lost sight of.....	20	6.6%
Died of intercurrent disease.....	11	3.6%
Died of hyperthyroidism.....	4	1.3%

Amongst the 190 cases "cured," a very large number show no remaining signs of the disease. Others, again, have to be careful, as much exertion is likely to cause exhaustion, but all can live useful and moderately active lives.

Gain in weight is a striking result of the treatment. The average gain where the patients were systematically weighed

(eighty cases) was seventeen pounds. Two cases, however, which were completely cured lost three pounds in weight. In some instances the gain in weight is quite marvelous, *e.g.*, a woman aged forty-four, height, five feet ten inches, was a living skeleton when she was carried in for treatment, weighing sixty-one pounds. At the end of her course of treatment by X-rays she was absolutely cured—the exophthalmos and goiter had disappeared and she had gained in weight no less than eighty-four pounds, weighing a hundred and forty-five pounds. Many other cases equally satisfactory but less theatrical could be cited.

In competent hands there is no risk of burning, of course. A burn would be certain evidence of gross ignorance or carelessness in administration.

Telangiectases sometimes occur, but I have not seen any since 1919. Two cases of atrophy of the laryngeal mucous membrane, have been brought to me, due to persistent over-treatment, but I have not seen any in my own work.

It is said that under X-ray treatment there is a fibrosis around the thyroid which interferes with surgical removal, but this is somewhat doubtful as this fibrosis is found in cases which have not undergone X-ray treatment, or in which the treatment is too recent or has not been sufficient to produce such a condition.

Real recurrences are very rare; we have had only two or three cases and these have again responded to treatment quite satisfactorily. The tendency to recurrence always suggests that there is some undiscovered source of sepsis and quite frequently the focus will be found in the teeth, sinuses, or in the alimentary tract.

In conclusion, I think we may be quite satisfied that X-ray treatment affords a safe and useful method of treatment which should be employed in all cases of this disease before resorting to the more drastic methods of the surgeon. In a very large majority of cases it will be found that an operation is quite unnecessary, and a pa-

tient will be enabled to lead a perfectly useful and satisfactory life.

#### DISCUSSION

DR. G. E. PFAHLER (Philadelphia): I regret that I missed part of the first paper. I enjoyed the part I heard, as well as the excellent paper by Dr. Barclay: I can agree, I think, with practically all that has been said by both. We have treated approximately 400 cases of hyperthyroidism. I do not have the statistics prepared to give you details. We treat our patients, however, once in four weeks, and we give a little larger dose than Dr. Barclay, but not much more, but we do it once in four weeks. He speaks of a third of a dose twice a week. I would be very much afraid of that. We give a third to a half of an erythema dose; that is, a third to half of a maximum dose once in four weeks. We count on treating the patient in the neighborhood of six to eight times. We try not to go over eight such treatments if we can avoid it, for fear of atrophy of the skin and telangiectasis. We treat the patient, however, at each visit with four different areas, two anteriorly and two posteriorly, with the idea of getting the effect on the posterior surface of the gland, dividing the anterior field and the median line and then taking the space corresponding approximately to the posterior line of the sternocleidomastoid or a line dropped from the angle of the jaw to the outer border of the sternocleidomastoid. We direct our rays downward and forward towards the upper mediastinum. We then turn the patient on his face and direct our rays from behind forward towards this same area. We use a nine-inch gap, five milliamperes, ten-inch distance, six-millimeter aluminum filter, twelve-minute exposure. We try in every way possible to protect the larynx, for in a few cases we have gotten very definite hoarseness and in one case it was persistent. Therefore, since obtaining this hoarseness, we have cautiously protected the larynx, and I think this is very important. In only one case have

we had recurrence of symptoms and we were not able to control these symptoms by further treatment and the patient died. As a whole, our results have been most satisfactory, and the physicians who were associated in every case have been highly pleased, as is indicated by the fact that the demand for this work is continually increasing. We try to begin the treatment of every case with a basal metabolism test, partly to assist in the diagnosis and to establish a record, but also to serve as a guide in determination of the case. In other words, when the symptoms have practically disappeared or have nearly disappeared and we think it is time to stop treatment, we make another basal metabolism test, and it serves as a very practical guide to us. As I have said previously before this Society, one of the practical tests that guide us very well is to test the patient sitting, count the pulse while he is sitting quietly, and then have him walk across the floor three times, come back, and sit down again. The average normal person's pulse will rise above ten beats. A hyperthyroid may rise anywhere from twenty to fifty beats, just from that slight exertion. If you make that test each time the patient comes, you will be able to form a practical idea as to the progress of the case. We not only take the pulse under those circumstances, but we record it under those circumstances, as well as record the weight. We also administer (when there is no objection on the part of the attending physician, or, at least, we suggest to him that he administer) five grains of quinine hydrobromide, which we think is helpful. We have not carried out the idea of administering lugol solution because, at least in two cases, we thought we thereby made the patient worse.

DR. ALBERT SOILAND (Los Angeles): One of the diseases which the average surgeon has not gracefully yielded to the radiologist for treatment, is hyperthyroidism. I was very glad to hear Dr. Barclay favor the term "hyperthyroidism" as an entity, and he has already given his reason for

that. I think it a very good name. About five years ago I reported 200 cases before this Society. At that time the metabolic test was not a routine procedure, therefore I do not believe that the classification made then was very satisfactory. We are now using the metabolic test routinely. There are several peculiar incidents about hyperthyroidism. The most striking is that it requires a larger dose of radiation to get satisfactory results than does any other condition I know of that is located so near the surface. Whether that is because of any peculiarity of the disease, I do not know, but we certainly have to give a larger total dose of radiation in hyperthyroidism than with other types of pathology as easily reached.

DR. LEDA J. STACY (Rochester, Minn.): I would like to ask Dr. Stevens if he and his co-workers have noticed any increase of the metabolic rate, as a reaction immediately following the treatment. We treated a small series of such patients at the clinic a few years ago, and that was one of the points observed. I might say that slamming of the door is not one of the features in the diagnosis of hyperthyroidism at the Mayo Clinic, but I think Dr. Plummer considers the testing of the muscular weakness of the legs to be one of the most valuable signs. The patient is asked to step up on the examining table without aid.

DR. R. E. LOUCKS (Detroit): The whole question of hyperthyroidism is of intense interest to me because about four or five years ago I reported 180 cases, after doing a metabolism. I would like to answer Dr. Stacy's question about the metabolic rate. When we first started doing the metabolism we were enthusiastic over it, trying out the metabolism three months following the treatment, and invariably we found an increased metabolism at two or three months. Then we discontinued taking the metabolism, because it somewhat dampened our enthusiasm, and for the last four years we

have been taking the metabolism at the end of six months, and have found that probably 80 per cent of the cases were either plus four or five or minus one or two. Every case, without exception, has a metabolism taken before treatment, at the end of six months after treatment,—and if there is a slight increase at that time it is taken again at the end of the year. You are probably all familiar with the reports I have given on the treatment of toxic thyroids in the last four or five years. Next week I hope to report 300 cases where the metabolisms have been taken. We have treated about 480 cases in the last eight years. I agree with what Dr. Stevens has said, except that he is somewhat modest about his clinical results, as he claims a percentage of only 65. With us, we conclude that we have had what you might call a complete control of all toxic symptoms in over 98 per cent of cases.

As regards Dr. Barclay's paper, I may say that in studying the condition of the thyroid in England, I have found it to be a very much milder type, and that they have it only in the midlands of England. They have a slight activity—what we call a functional activity—along the border of the sea. The type we have in America is much like the one they have in Switzerland. I have made a study of the Swiss thyroid cases, at two different periods, and find that they correspond very much with the type of cases we get in the inland states of Michigan, Wisconsin, Illinois and Minnesota.

My experience of radiation therapy in toxic thyroid has been exclusively with radium. I have no doubt but that similar results with X-ray are obtainable by experienced therapists like Dr. Pfahler and Dr. Stevens, yet I question the advisability of treating the gland from the posterior surface, as reported just now by Dr. Pfahler. A massive adenoma of the gland might be benefited, yet the enlarged types distort the shape and position of the trachea, so that too much radiation might be given

the mucous surfaces, with a resulting tracheitis.

Only the large adenomas, with or without cystic formation, that cause pressure symptoms, should be referred to the surgeons for thyroidectomy. Many of the cystic types (where there is not too much hypertrophy) are responding to doses of 100 to 150 milligrams of radium. I have never seen a case of hypothyroidism following radium treatment, neither have I seen a tracheitis, laryngitis or any indication of atrophy of the skin or mucous membrane. Occasionally there was some telangiectasia of the skin with my earlier cases.

The first symptoms of a toxic thyroid, as Dr. Stevens emphasizes, are the tremor and decrease in body weight, so that after treatment when you note a control of the tremor and increase in weight you are confident of the early benefit of your therapy.

The last symptom to respond is the tachycardia. A heart beat of 160 with fibrillation, flutter, etc., before treatment, should quiet down to 110 or 120 at the end of six months after treatment, and gradually improve with the toxic condition controlled. Very often in long-standing toxic cases there is a nervous irritability of the heart that does not respond completely, no doubt due to some endocardial degeneration, so that any sudden shock or excitement will send the heart into a temporary flutter and give symptoms of a slight angina.

DR. R. H. STEVENS (Detroit): I have one case of hyperthyroidism with marked myxedema after X-ray treatment, to report. The case was an extreme one of hyperthyroidism with a metabolic rate around 45, as I remember it, plus, and a very sick patient, in bed. We gave her two series of treatments with high voltage current, using small doses, less than half the erythema dose, in the substance on the tumor, over a period of two weeks, giving small doses from one to three days apart. These two doses were repeated over two months apart. We then gave her another dose later on with the ordinary eight-inch



gap technic, something similar to what Dr. Pfahler has reported. The patient was completely well, apparently, for about eight or nine months, and then suddenly developed a marked hypothyroidism, the myxedema being very, very marked. The administration of thyroid soon relieved her, but she is still taking thyroid and with that is in apparently very good health. The metabolic rate, at the time when we noticed the hypothyroidism, was minus 17. When we saw her last, taking her metabolic rate a few months before that, it was down to ten or twelve, plus,—I have forgotten just the rate,—but whether this was due to the X-ray treatment or not, I do not know.

DR. J. T. STEVENS (closing): Dr. Stacy has asked whether I have ever observed any increase in metabolic rate following treatment. No tests have been made immediately after treatment, therefore I am unable to answer this question positively and at the same time present proof. Our patients are advised to go to bed and let nothing interfere with absolute rest for a few days following treatment. In the case which was reported in detail, had a test been made, I presume that it would have been found to be elevated over that taken before treatment. However, I do not believe that the treatment had anything to do with the increase in toxic symptoms immediately following the last treatment, because at the time of treatment all symptoms were gradually rising. At the present time practically all symptoms have disappeared without any further specific treatment.

I am much interested in Dr. Loucks' percentage of cures. My percentage of cures is 75. If I exclude the patients who were lost, those who were unmanageable, those who took only one or two series of treatments, or those who gave the treatment an unfair trial, my percentage of cures immediately rises up to equal his.

I am very much interested in the cases of hypothyroidism that have been reported, because I have not seen one such case, in spite of the fact that I have been on the

watch for it. In the cases reported by Dr. Barclay, I should like much to know whether or not they have remained as hypothyroid cases, or whether they have recovered. Are they still on thyroid feeding, and, if so, how long have they been under such treatment? Since taking his seat Dr. Pfahler has told me of one case which he has had, in which instance the patient was put upon thyroid gland for six months, the treatment being followed by recovery. The gland was discontinued, and the patient has remained perfectly normal.

Dr. Chapell likes to limit his treatments to three series, and, if he does not see improvement, refer the case for surgical treatment. I do not think that in all cases one can decide that three series of treatments is the limit to give in the presence of positive symptoms which point to a stationary case; some may get marked improvement in one series, others may not show improvement in from three to five series of treatments. In my clinic the average number of series of treatments from start to finish is seven. I feel that each case must be individualized.

DR. A. E. BARCLAY (closing): I do not think there is anything for me to add, except as to the occurrence of myxedema following hyperthyroidism. It so happened that the series did not include any of these cases. I remember two cases, however; one was a doctor, in practice, who developed myxedema about three or four months after he finished X-ray treatment. He was put on thyroid and has remained in practice ever since, and I see him from time to time and he carries on perfectly well. The other was a hospital case and she also is perfectly well, with extract of thyroid. I like Dr. Loucks' statistics very much, but I cannot get such figures myself.

As to the rapidity of response to X-ray treatment: The first signs are usually evident in two or three weeks. If a patient is not showing a definite response in six weeks, then there is something wrong and

we go over that case very carefully for sepsis, particularly dental, frequently finding something. Occasionally we find that that patient has developed a thyroid thirst and then, of course, we refer him straight back to the physician and in quite a number of cases it has been found that glycosuria is developing.

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## ROENTGENOGRAPHIC EXAMINATION OF THE SPHENOID SINUSES<sup>1</sup>

By AMÉDÉE GRANGER, M.D., F.A.C.R., O.d'A. (France), Director of the Department of Radiology, Charity Hospital, Professor of Radiology, Post-graduate Medical School, Tulane University, NEW ORLEANS, LA.

THE reasons for writing this paper are:

1. To present in concrete form the result of our experimental and clinical study of the sphenoid sinuses with the roentgen rays during the past three years.

2. To demonstrate the necessity for a rigid adherence to our technic.

3. To answer constructive criticisms.

4. And lastly, to prove the superior diagnostic value of our method.

As the logical development of the naso-frontal and naso-mental positions and while attempting to obtain greater uniformity and better duplication when making roentgenographs of the sphenoid, we devised the head rest or sinus mask, without which the alveola-glabella position of the head would be impossible.

In a former communication (1) we showed the uniformity obtainable with the use of the alveola-glabella position when making roentgenographs of different heads, and the duplication possible with the same head.

We recommended a 107° angle inclination of the head and the use of a vertical ray for the best unobstructed view of the sphenoid sinus, and showed constant and clearly visible landmarks for the upper boundaries of the sphenoid and ethmoids (2). In a later communication (3), we proved what anatomical structures produced these landmarks and emphasized the diagnostic importance of the curved sphenoid line, or Granger line, and of the sphenoid region included between that line and one lower down which forms the upper border of the ethmoids. (See key plate, Fig. 1.) This region represents the upper anterior portion of the sphenoid sinuses projected through the frontal sinuses.

This view is best obtained (as shown in Fig. 2) by placing the cassette covered with the sinus board or mask on a 17° angle block arranged so as to give to the sagittal plane of the head a 107° inclination. The

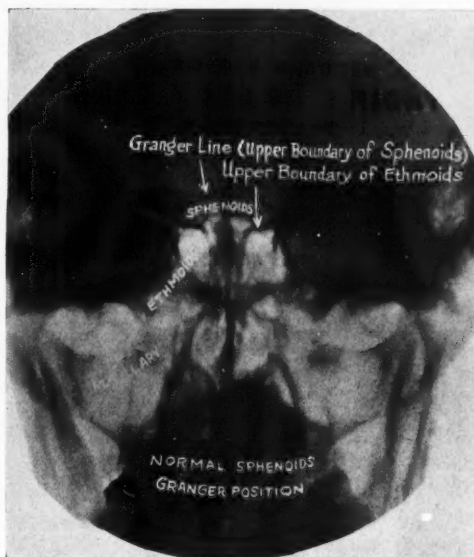


Fig. 1. Key Plate.

nose must be inserted in the aperture in the sinus mask, and the upper jaw (alveola) and a line uniting the eyebrows (glabella) must rest firmly on it. The central ray is directed vertically through the head on a line just below the external auditory meatus. *We cannot insist too strongly upon the fact that the head must rest and bear firmly and evenly on the alveola and the glabella, and that the angle block must have an angle of exactly 17°.* If this is done, the roentgenographs will resemble the key plate, Figure 1, and B of Figure 3.

It will be noted that in both these roentgenographs the shadow of the petrous bone is situated in about the center of the orbit and does not extend beyond the upper or

<sup>1</sup>Read before the Radiological Society of North America, at Atlantic City, May, 1925.



Fig. 2.

lower borders of the latter. If the angle of the block is equal to or greater than  $19^\circ$ , instead of the prescribed  $17^\circ$ , or if the glabella and forehead make better contact

than the alveola (upper jaw), the resulting roentgenograph will resemble A of Figure 3, wherein the G line is shortened, the sphenoid region diminished, and the



Fig. 3. Roentgenographs of skull to illustrate the effect of change in position or angle on views made in the Granger position. (A) Angle is too great or head bears more on the forehead than on the upper jaw. (B) Angle correct,  $17^\circ$ , and head bears equally on the alveola and glabella. (C) Angle is too small and head bears more on the upper jaw than on the glabella.



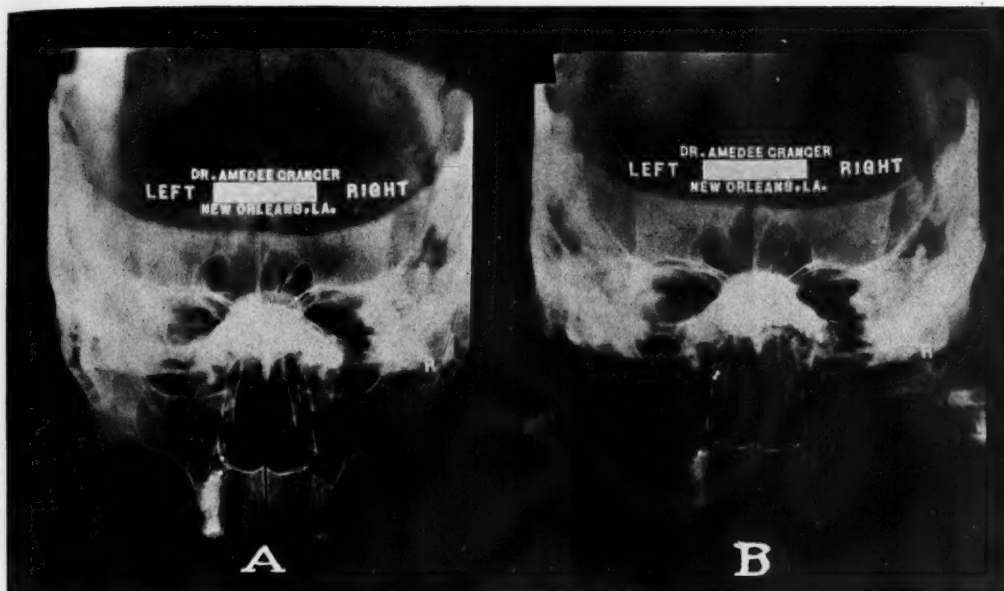


Fig. 4. Roentgenographs of a skull with the right sphenoid partly filled with very fine shots, to illustrate the different results obtained when the  $17^\circ$  inclination is given to the central ray, A, and to the head, B. (See text.)

shadow of the petrous bone is seen extending above the upper border of the orbit, leaving the lower half of the latter noticeably free of shadows. If on the other hand the angle of the block is  $15^\circ$  or less, instead of the prescribed  $17^\circ$ , or if the upper jaw (alveola) makes better contact than the forehead (glabella), the roentgenograph will resemble C of Figure 3, wherein the G line and the sphenoid region are absent and the shadow of the petrous bone is seen extending below the lower margin of the orbit, leaving the upper half of the latter noticeably free of shadows.

Aspray (4) has described an oblique postero-anterior view of the head for the examination of the sphenoid sinuses, which gives roentgenographs practically identical with those obtained in our position. The following essential differences exist between his technic and ours. He places "the patient prone on the table with the forehead and nose touching the cassette. The central ray is directed through the head in the postero-anterior direction at an average angle of  $18^\circ$ ." While we also

place the patient prone on the table, we make the glabella and alveola bear with equal pressure on the sinus board or mask and cause the central ray to pass vertically in a postero-anterior direction through the head, which is inclined at exactly  $17^\circ$  from the perpendicular so as to form the required  $107^\circ$  angle.

Roentgenologists of Aspray's experience may obtain uniformity and duplication with his technic, but the large majority of roentgenologists, who are less experienced than he, will most assuredly fail to do so. Furthermore, although it is possible to produce the same projection of the anatomical structures by giving to the head or to the central ray the same degree of inclination, the projection of the shadow of the free contents of the sphenoid sinuses—whether pus, or, as in the case of our experiment, very fine shots—will be quite different. In Figure 4, which shows roentgenographs of the skull having the right sphenoid sinus partly filled with very fine shots, View A was made with the central ray directed at an angle of  $17^\circ$  and the head held in a

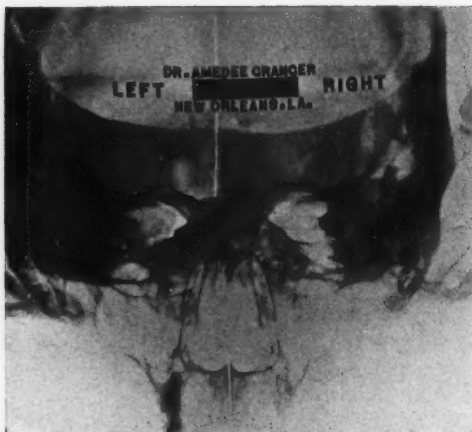


Fig. 5. Roentgenograph of a skull with left sphenoid and the right frontal sinuses filled with plaster of Paris. The Granger line is invisible on the left and clearly visible on the right.

postero-anterior position, while View *B* was made with the central ray directed perpendicularly in a postero-anterior direction through the skull, inclined  $17^\circ$  from the perpendicular so as to form the required  $107^\circ$  angle. It will be noted that while the projection of the anatomical structures is identical in both views, in *A* the *G* line is visible on the right side and a definite clear space exists between it and



Fig. 6. Postero-anterior,  $23^\circ$  angle, alveola-glabella view of a head. The right frontal maxillary and ethmoids are cloudy.



Fig. 7. Postero-anterior,  $107^\circ$  angle, alveola-glabella view (Granger position) of the same head as shown in Figure 6. All the sinuses are opaque on the right side, but the Granger line is clearly visible.

the shadow of the shots, and in *B* the *G* line is not visible and the shadow of the shots extends to the point where that line should be seen. Our experience in the past three years has proved to us conclusively that pus in the sphenoid sinuses behaves in a similar manner, flowing down to the *G* line, which in our position becomes the lower-

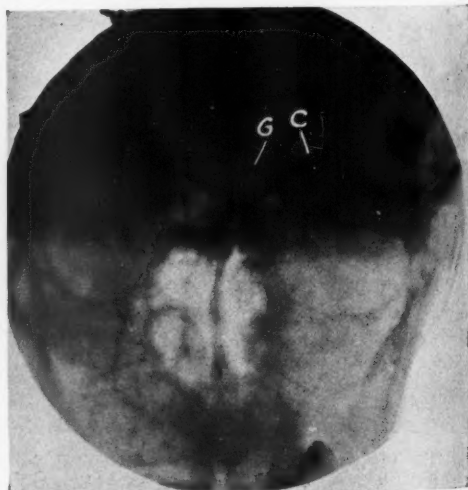


Fig. 8. Empyema of the left sphenoid sinus.

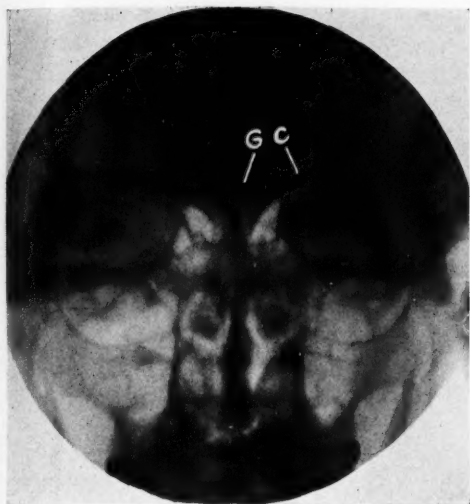


Fig. 9. Hyperplastic sphenoiditis on the right side.

most portion of the sphenoid sinuses, and causes it to become invisible. It must be clearly evident from the above that the inclination should be given to the head and not to the central ray.

Since we laid so much stress on our observation that pus in the sphenoid causes the G line to become invisible, and since the sphenoid with our technic is projected through the frontal sinuses, it was imperative to determine what effect, if any, pus in the frontal sinuses would have on the visualization of that line. Experimentally and clinically, it is shown that the pathology of the frontal sinuses has no effect on the visualization of the G line. Figure 5, which is a roentgenograph of a skull with the left sphenoid and the right frontal sinuses filled with plaster of Paris, shows the G line to be invisible and the sphenoid region dense on the left side, the frontal sinus remaining clear. On the right side the frontal and sphenoid regions are cloudy, but the G line is clearly visible. Figure 6, which is the postero-anterior, 23° angle alveola-glabella view of a head, shows the right frontal, maxillary and ethmoids opaque. Figure 7, the postero-anterior, 107° angle alveola-glabella view

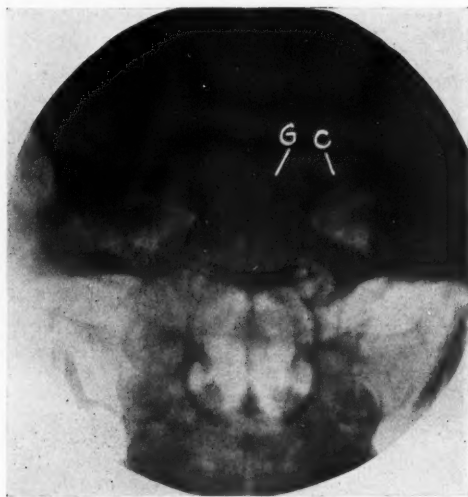


Fig. 10. Polypoid degeneration of the right sphenoid.

(Cranger position) of the same head, shows the same sinuses opaque on the right side and the G line clearly visible. Purely on this finding, we excluded the sphenoid sinus while making the diagnosis of pan-sinusitis on the right side, and our interpretation was confirmed.

In previous communications to this Society, we expressed our conviction that this line was not only the most important land-

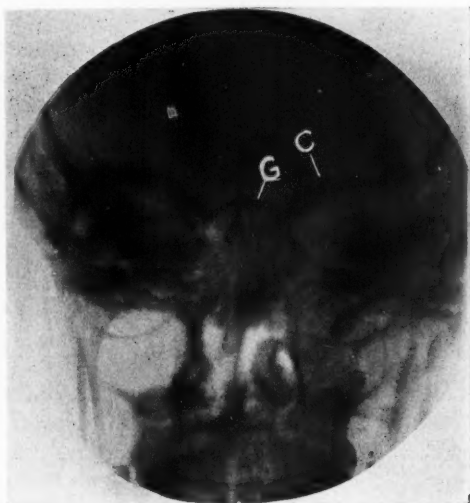


Fig. 11. Osteoplastic changes in the right sphenoid.

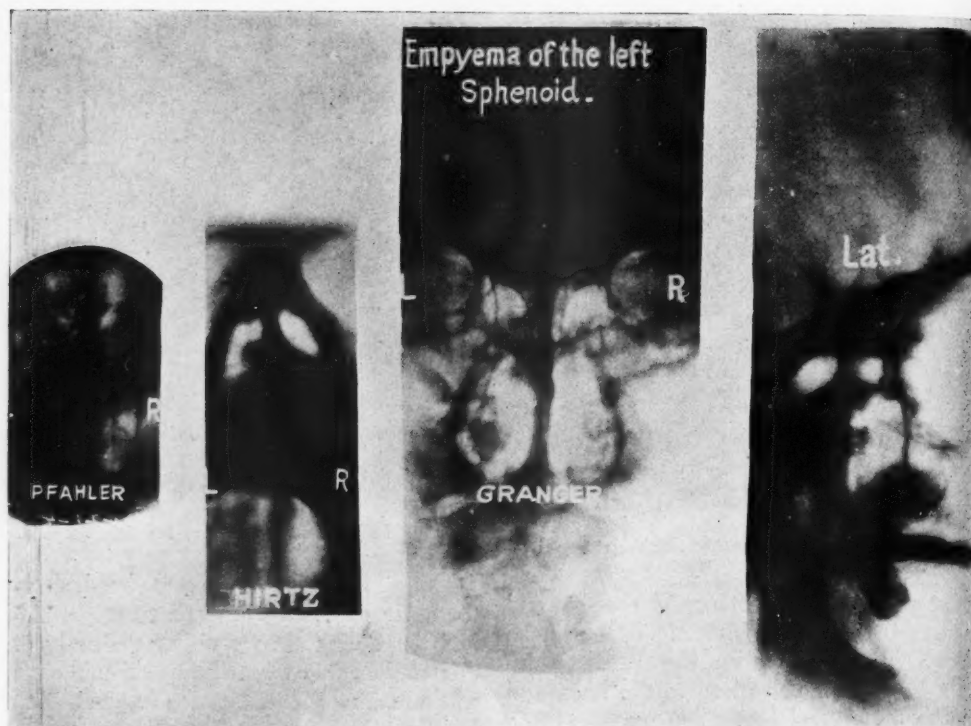


Fig. 12.

mark to be seen on roentgenographs of the sphenoid, but that it had definite diagnostic value, and at the Rochester meeting in December, 1923, we reported a number of cases in which our diagnosis of sphenoid pathology, based on a study of the G line, had been confirmed. After nearly eighteen months more of practice and observation, we have reaffirmed the statements made at that time. Our interpretation of sphenoid pathology is based on the following findings, concisely stated and illustrated by the following typical proved cases:

*Empyema* (left): Fig. 8. The G line (on the left) is invisible.

*Hyperplasia* (right): Fig. 9. The G line (on the right) is less dense, its lower border is indistinct and it is usually broadened.

*Polypoid* (right): Fig. 10. The G line (on the right) is invisible but its location is indicated by the convex upper border of the very opaque sphenoid and ethmoid regions.

*Osteo-plasia* (right): Fig. 11. The G line (on the right) is broadened and occasionally denser.

In each instance our findings can readily be accounted for by the existing pathology. In empyema, the pus gravitates down to the most dependent portion of the sphenoid wall, and its shadow, blending with that of the latter, causes it to become invisible. In hyperplasia, the broadened line, with indistinct lower edge, is caused by the hyperplasia of the periosteal or perichondral membrane and the diminished density of the line is due to the resulting bone atrophy.



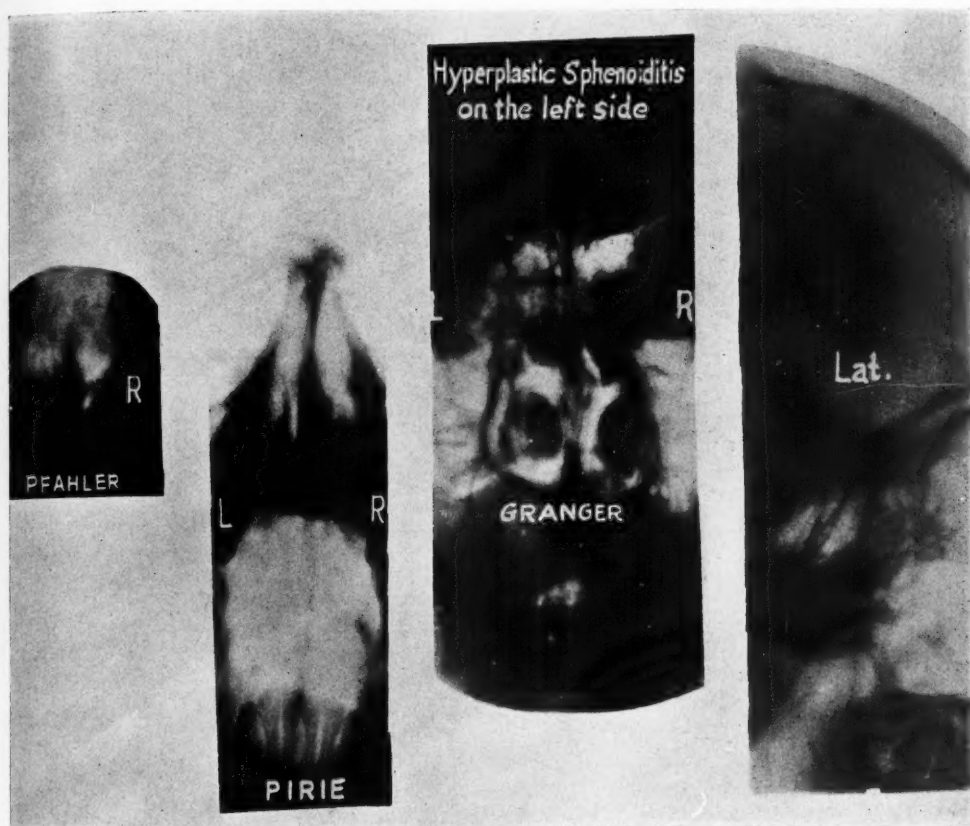


Fig. 13

In polypoids, the sphenoid and ethmoids become very opaque, because they are filled with polypoid tissue instead of air, and the opaque shadow thus formed blends with and obliterates the shadow of the G line. In osteo-plasia the line is broadened without loss of density or sharpness of outline because of the osteo-plastic changes.

Months ago we proved conclusively that with our technic the roentgen examination of the sphenoid sinuses could be standardized, even in a large clinic (Department of Radiology, Charity Hospital), where all the roentgenographs are made by non-medical technicians, and that better comparisons were possible when studying roentgenographs of the same patient taken at different times, and even those of different patients. Later on, as our experience

with the method grew, we proved to the entire satisfaction of a large otolaryngological staff that more accurate roentgen diagnoses of sphenoid pathology were possible and that hyperplastic sphenoiditis, by far the most common pathology of the sphenoid which we have seen and the most difficult to recognize by other methods because, in the majority of these cases, there is no appreciable difference in density between shadows of the two sphenoid regions, could be definitely and positively diagnosed.

Several members of the Eye, Ear, Nose, and Throat Club of New Orleans urged us to examine a number of cases of suspected sphenoid pathology by different methods, including our own, and to present the result of this study, together with the roent-

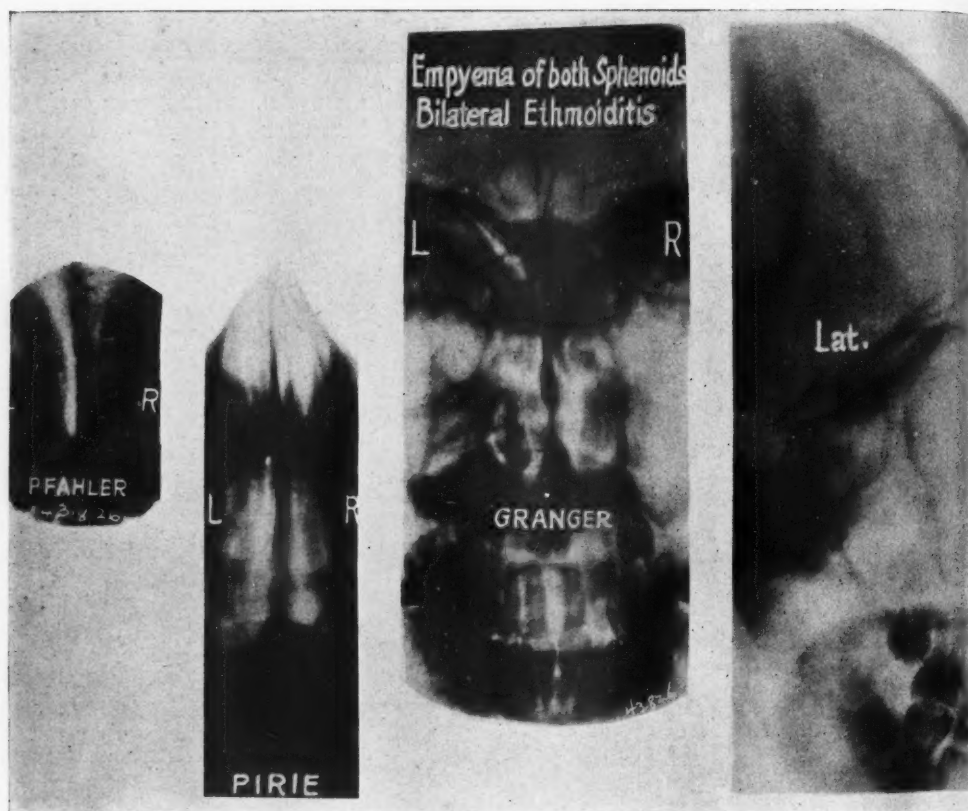


Fig. 14.

genographs, to the Club at some date in the near future. As this seemed the fairest, surest, and quickest way to determine which method possessed the greatest diagnostic value, we agreed to do it.

Accordingly we examined seven cases of suspected sphenoid pathology referred to our Department at the Charity Hospital, making in each case roentgenographs in the Pfahler, Pirie or Hirtz, lateral and Granger positions. Three of these patients either never returned to the Clinic or refused further examination, treatment, or operation. Very brief histories, with the roentgen and otolaryngological findings of the other four cases, follow:

No. 42,124 (Fig. 12). Complained of headache, pains in back of neck and dripping in the nasopharynx. *Roentgen find-*

*ings:* Left sphenoid opaque in the Pfahler and Hirtz films. *Roentgen diagnosis:* Sphenoid pathology. The G line is invisible on the left side in the Granger film. *Roentgen diagnosis:* Empyema of the left sphenoid. The sphenoid is apparently clear in the lateral film. *Otolaryngological finding:* Pus in the left sphenoid.

No. 42,582 (Fig. 13). Neuritis of the left optic nerve, causing blindness in the left eye. About two years ago this patient was blind in the same eye for over two months and his vision did not return fully for nine months. *Roentgen findings:* We are not able to see a definite difference in the density of the two sphenoids in either the Pfahler or the Pirie films. *Roentgen diagnosis:* No pathology of the sphenoids. In the Granger film the G line is less dense

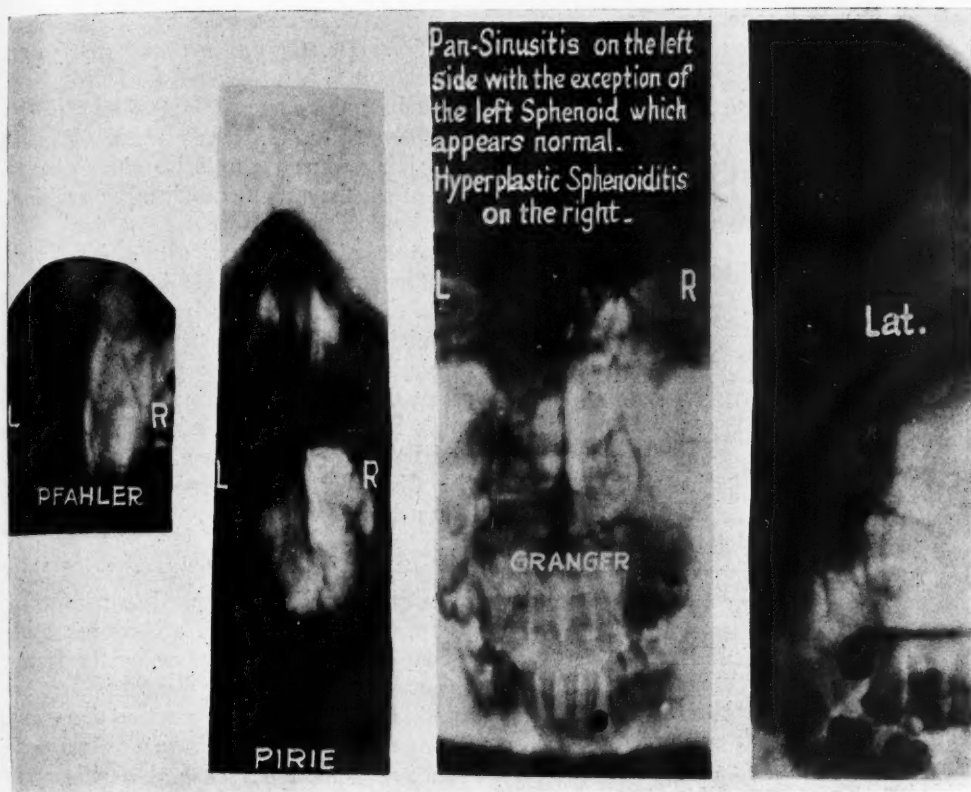


Fig. 15.

and distinct on the left side. *Roentgen diagnosis:* Hyperplastic sphenoiditis on the left side. The sphenoid is clear in the lateral film. *Otolaryngological findings:* Hyperplastic sphenoiditis on the left side. The vision in the left eye was almost completely restored after one month of treatment for the sinus condition.

No. 43,826 (Fig. 14). Patient admitted to the hospital, suffering with intense headache. *Roentgen findings:* The two sphenoid sinuses are opaque in both the Pfahler and Pirie films. *Roentgen diagnosis:* Sphenoid pathology. The G line is invisible in the Granger film. *Roentgen diagnosis:* Empyema of both sphenoids. The sphenoid is opaque in the lateral film. *Otolaryngological finding:* Pus found in both sphenoids.

No. 43,245 (Fig. 15). Admitted with temperature  $104^{\circ}$ , high leukocyte count,

cellulitis of the left side of the face and the left nares completely occluded. *Clinical diagnosis:* Pan-sinusitis, including the sphenoid on the left side. *Roentgen findings:* The left sphenoid is opaque in both the Pfahler and Pirie films. *Roentgen diagnosis:* Pathology of the left sphenoid. In the Granger film the G line is clearly visible on the left side, and it is less dense and not so clearly outlined on the right side. *Roentgen diagnosis:* No pathology of the left sphenoid. Hyperplastic sphenoiditis on the right side. The sphenoid appears quite clear in the lateral film. *Otolaryngological findings:* Pus was found in the left frontal, maxillary and ethmoids, but no pus was found in the left sphenoid, which was opened because it did not seem possible to the otolaryngologist that with the quantity of pus found in the other sinuses and with the occlusion of the nares

interfering with proper drainage, the sphenoid could have escaped infection. He not only found no pus, but reported that the sinus appeared perfectly normal. The right sphenoid was also examined and found to be hyperplastic, but to contain no pus.

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#### DISCUSSION

DR. C. C. GRANDY (Fort Wayne, Ind.): When Dr. Granger came out two years and a half ago with his new technic, I was much interested in his work on standardizing this position, and as soon as I could get in touch with him, I got one of his Granger masks and commenced working with it. I found that I could duplicate his work absolutely in that position, and it is a great satisfaction to me to take a case of suspected sphenoid disease, and put it into that position. It is easy to get into the trick,—just like one, two, three, and your films are all alike. Dr. Granger has his technician do it and so do I have mine. It seems to me the important thing is what he calls the G line, and that line is constant; I like to look at it, not as making a diagnosis as to pathology,—I like to see a clear-cut G line, when I can say there is no pathology. In other words, a negative report to me is more valuable than a positive. I am not able to pick out these fine points as Dr. Granger does, and I would much rather see a clear-cut sharp line on both sides. I think he is to be congratulated on being able to do this, especially on these four test cases, when it came down to the final operative proof.

DR. L. A. FORTIER (New Orleans): I am from Dr. Granger's own home town, and I want to bring a word up here to you as to how the specialists of New Orleans feel about Dr. Granger's work. Almost invariably when they send a sinus case to any of us, they ask for a Granger position, and I think that means a great deal. As to the technic, or the difficulty of it. I visit the Charity Hospital once in a while and know that Dr. Granger has to change his technicians. He seems to have no trouble in having them learn the positions and all about the technic of taking these cases. I think Dr. Granger is to be congratulated and I think he has made a step forward in the diagnosis of sphenoid and ethmoid sinus diseases.

DR. I. S. TROSTLER (Chicago): I have been doing so little diagnostic work during the past few years that I seldom see sphenoidal sinus cases. I am using the frame recommended by Dr. Granger for the making of general sinus examinations, and have adopted it for use in the Waters position by fixing the frame at a 45-degree angle, as illustrated by me in *RADIOLOGY* some months ago. I find that I am able to exactly duplicate film after film in identically the same position.

I am certain that Dr. Granger has given us something of enormous value in sinus work and that he is to be highly commended for his persistence in presenting the subject to us so that we will get it clearly fixed in our minds, and in that way get the value of it.

I confess that I am not able to make the fine diagnoses that he is able to do by his method, but this may be due to the fact that I do not do a sufficient volume and do not see enough patients to properly differentiate and diagnose the same.

DR. GRANGER (closing): I do not think there is anything I can add, but I will, however, again call the attention of the members to the fact that with this method they have a positive check on their own and on



the work of their technicians. Simply observe the orbit, and make sure that the shadow of the petrous bone is reasonably within its center. When the shadow of the petrous bone extends above the upper limit of the orbit, either the angle of the block is too great (more than  $17^\circ$ ) or the forehead is making too great a contact. On the other

hand, when the upper half of the orbit is free of shadow and the shadow of the petrous bone extends below the lower margin of the orbit, the jaws are making better contact than the forehead, or the angle of the block is too little (less than  $17^\circ$ ). I wish to thank the gentlemen who took part in the discussion.

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## THE RÔLE OF TEMPERATURE OF THE OPAQUE MEAL IN THE FILLING OF THE DUODENAL CAP<sup>1</sup>

By ROBERT A. ARENS, M.D., and ARTHUR R. BLOOM, M.D., Roentgenologist and Fellow in Radiology, respectively, Michael Reese Hospital, CHICAGO, ILLINOIS

IN common with other roentgenologists, we have experienced difficulty by having to wait for a considerable period of time, after a patient ingested an opaque meal, before the bulbus duodeni filled out sufficiently well in order that films might be taken. We had been under the impression that warm opaque meals caused the duodenal cap to fill out more rapidly than cold meals. Because of this, we heated the meal to about body temperature before using it in our routine examination of gastro-intestinal cases. Our belief was due to our general understanding of the physiologic principle that warmth causes a relaxation of muscle and cold causes a contraction or spasm. L. v. Friedrich (1), in his experiments, had shown that heat stimulated the motor function of the stomach and caused a relaxation of muscle spasm. M. Lüdin (2) demonstrated that heat applied locally to the abdomen shortened the emptying time in pylorospasm. However, Egan (3), by means of the fluoroscope and opaque meals, found that there were three types of stomach reactions as regards emptying time: (1) An immediate emptying by the stomach into the duodenum without perceptible action on the part of the stomach; (2) an emptying by the stomach into the duodenum immediately after it had become filled, and (3) the remaining of the fluid in the stomach for some time after ingestion of meal before passing into duodenum. These reactions were independent of the temperature used or the pathologic condition.

In order to determine the effect of variation of temperature on the filling of the cap, we undertook the following experiment. The patients were taken just as they came for the routine gastro-

intestinal examinations, regardless of their history or pathologic conditions, with the exception, however, of those in whom there was definite total or partial obstruction. By means of a stop watch, the time it took for the bulbus duodeni to become completely filled after the barium reached the pyloric end of the antrum was noted. The stomachs were not manipulated, so that in no case was the cap filled artificially or mechanically, but physiologically. We gave the first group, which consisted of 25 patients, cold meals varying in temperature from 35° F. to 60° F. A second group, consisting of 38 individuals, were given meals varying from 61° F. to 90° F. The third group—23 subjects—were given hot meals varying from 91° F. to 110° F.

The results of our findings (Tables I and II) were quite surprising, although in general they substantiated those of Egan. We noted that in 43 per cent of the patients the caps filled out immediately, regardless of the temperature of the meal used or the pathologic condition present. In about 11 per cent there was a delay of over five minutes. From Tables I and II it can be seen that the figures are so similar that one must come to the conclusion that the temperature of the meals has no effect on the time it takes for the cap to fill out.

To further demonstrate this fact and to have a control of a group of normal individuals, we examined 18 nurses who had no history of gastro-intestinal symptoms. At first they were given meals the temperature of which varied from 32° F. to 36° F., and the time required for the cap to become fully filled recorded. About a week later they were again given the barium meal. At this time the temperature varied from 70° to 150° F. (See Table III).

In the majority of cases there was no difference whatever in time. In the other

<sup>1</sup> From the Radiological Laboratory and the Otto Baer Fund for Clinical Research of the Michael Reese Hospital.

TABLE I

Temperature Time in sec.	35°-60° F.					61°-90° F.					91°-110° F.					Total
	0-5	6-30	31-120	121-300	301 up	0-5	6-30	31-120	121-300	301 up	0-5	6-30	31-120	121-300	301 up	
No gastro-intestinal path.	1	1	1	1	1	3	3	2	2	3	5		2		1	26
Pathologic gall bladder.	5	2		1		9		4		1	3	1	1	1	2	30
Duodenal ulcer	3	1		1		2		2	1		2		3			16
Chronic appendicitis		2			1	3		2				1				9
Malignancy of colon				1						1						2
Colitis	1			1												3
Total	10	6	3	4	2	17	3	10	3	5	10	3	6	1	3	86
					25					38					23	
Percentage	40	24	12	16	8	44.7	7.9	26.3	7.9	13.2	43.5	13.0	26.1	4.3	13.0	

These cases divided according to pathologic condition and the effect of various temperatures on the time it takes to fill the cap.

TABLE II

Temperature Time	35°-60° F.		61°-90° F.		91°-110° F.		Total	
	Total	Per cent	Total	Per cent	Total	Per cent	Total	Per cent
Immediately to 5 sec.	10	40	17	44.7	10	43.5	37	43.2
6 sec. to 30 sec.	6	24	3	7.9	3	13	12	14
31 sec. to 2 min.	3	12	10	26.3	6	26.1	19	22
2 min. to 5 min.	4	16	3	7.9	1	4.3	8	9.3
5 min. upward	2	8	5	13.2	3	13.1	10	11.6
Total	25	100	38	100.0	23	100.0	86	100.0

These cases are grouped according to the time it took the caps to fill.

TABLE III

Cold Meals		Warm Meals	
Temperature (in deg. F.)	Time	Temperature (in deg. F.)	Time
36	7 min. 0 sec.	100	7 min.
36	1 " 30 "	150	2 "
36	6 " 5 "	120	6 " 30 sec.
36	" 8 "	110	1 " 40 "
36	11 " 20 "	70	10 "
36	1 " 12 "	110	1 " 14 "
32	5 " 30 "	70	8 " 42 "
32	1 " 10 "	75	1 " 42 "
32	" 30 "	80	2 "
36	2 " 40 "	120	1 " 12 "
36	3 " 40 "	120	" 45 "
36	5 " 10 "	100	6 "
36	6 " 4 "	100	6 "
36	Immediately	100	Immediately
32	4 min. 40 sec.	100	4 min. 44 sec.
36	7 "	110	2 "
36	1 "	150	6 " 25 "
36	4 " 12 "	120	1 " 25 "

Group of nurses as normal control. This table shows the time it took to fill the cap after cold and warm meals.

cases the differences noted were so diversified that they could not be formulated into any rule.

It is a well known fact that in some cases the cap fills immediately under the fluoroscope but empties before films can be taken,

while in other cases the cap fills and remains filled so that films can be taken at once. In order to determine whether or not the temperature of the meal had any effect on this phenomenon in these two types of cases, we ran two groups, the first being given warm meals and the second, cold meals. No appreciable difference could be observed in these cases which could be attributed to the temperature of the barium meal.

In general, our findings substantiated those of Egan; that is, there is no effect upon the filling time of the cap due to the

temperature of the meal. The practical application of these findings led us to the conclusion that opaque meals should preferably be given cold, as they can be made considerably more palatable than warm ones. As a minor consideration, there is no time or trouble expended in heating up the barium meals.

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## ROENTGEN-RAY THERAPY OF GASTRIC AND DUODENAL ULCERS AND OTHER BENIGN AFFECTIONS OF THE GASTRO-INTESTINAL TRACT

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### PRACTICAL RESULTS IN GASTRIC AND DUODENAL ULCER

**M**ALIGNANCIES of the gastro-intestinal tract are intangible to the roentgen rays. Among the large number of diseases which are often favorably influenced or cured by this method is ulcer of the stomach and duodenum. It is only pathologically-anatomically benign; clinically it must be regarded from a different viewpoint, since its duration and complications, the discomfort caused by it, and, last, but not least, the ultimate therapeutic and often enough unsuccessful refuge to nearly total resection of the stomach are rather serious facts, making it appear less benign.

Besides ulcer, hyperacidity and spasms will be considered. Roentgenotherapy of these conditions developed empirically; its theoretical basis was found later and is still incomplete.

A number of authors have cleared the way to our present results: Bruegel (1916), treatment of hyperacidity; Wilms (1916), two cases of pylorospasm cured by roentgenotherapy; treatment of ulcer described by Kodon, Bruegel, Menzer, Schulze-Berge, Matoni, Strauss, Kottmaier, Lenk. Some of these writers believe, by misinterpretation, that results of treatment of gastric ulcer are mainly due to reduction of the hyperacidity. Other reports are not definitely convincing, because of the lack of decisive diagnosis.

Starting with the treatment of insufficiently functioning gastro-entero-anastomosis, we treated only ulcers, roentgenologically proven.

In simple hyperchlorhydria a lowering of the acidity, often below normal, is usually found one day after the treatment. In the average case it gradually recurs, but

after application of (usually) three series, remains permanently normal and causes no more discomfort.

The frequent intermittent cramps of cardiospasm can be influenced only psychically. No benefit can be expected in idiopathic esophageal dilatation with cardiospasm, the etiology of this condition apparently being a degeneration of the vagus nerves, and also the ones elicited by degeneration of the vagus nuclei.

Dealing with ulcers of the stomach and duodenum, Matoni reports one hundred forty cases and 77 per cent complete clinical cures, 13½ per cent considerable improvements, 91½ per cent failures. His report is not beyond doubt. So far we ourselves have treated fifty to sixty patients with definitely established ulcers, and observed forty-three over longer periods. Twenty-one are free of discomfort; in thirteen very light complaints persist or have recurred; five report only slight improvement, four are uninfluenced. We have some cases, observed over a number of years, of complete recession of all discomfort and clinical evidence. (Two case histories show the characteristic feature of beginning improvement two to four weeks after the *first* series of treatment: all successful cases respond in that way.)

### OBSERVATION OF ULCER SYMPTOMS

The cramping pains diminish or disappear within ten to fourteen days, occasionally after exacerbation; localized tenderness to pressure is more persistent. The spontaneous attacks of epigastric pain, being usually explained as spastic muscular contractions, favor the conclusion that their improvement is due to lysis of spasms.

Due to the disappearance of pain increased appetite and gain in weight are

observed. Hyperacidity recedes early after treatment in but a small number of cases: in the majority it is not at all or very little influenced. In some of these cases normal acidity occurs later following or without further treatment. No relation however was found between complaints and objective symptoms and acidity. We are convinced that hyperacidity is far less important than is usually assumed for the etiology of ulcer and the genesis of complaints.

Hemorrhage usually comes to a standstill within a few hours or, at least, one to two days following treatment. This effect is in all probability due to irradiation of liver and spleen, which, according to Stephan and Tichy, results in increased blood coagulation. (Two case histories show effects of treatment upon hemorrhage.)

Chronic spastic constipation, a very troublesome symptom not infrequently associated with ulcer, is in most of the cases reported as spontaneously and completely overcome very soon after treatment. This fact is of great theoretical interest, proving that constipation is not caused by hyperacidity but is independent of it and rather a co-ordinate or secondarily appearing symptom of probably vagotonic etiology.

Disturbances in motility, *i.e.*, 6-hour retention, sometimes recedes quickly, sometimes remains uninfluenced. The former group, we believe, is of spasmodic origin—pylorospasm; the latter, due to hypersecretion and hyperacidity, rarely yields results.

It is of particular interest to see how a niche, the most readily recognized and significant objective symptom of an ulcer, usually reduces in size or disappears quite quickly with cessation of objective symptoms. This, however, does not yet mean a cure; rather, must be considered as relief of a spasm, which, in the opinion of Hau-deck, is responsible for the niche-symptom in non-penetrating ulcers. We are permitted to speak of an anatomical cure only if a niche disappears permanently.

Spasm of the circular layer of muscular tissue in the segment involved by the ulcer in the average case remains noticeable as long and sometimes longer than localized tenderness to pressure exists. Secondary changes, like scars of the mucosa or deeper layers, of course, are never affected by treatment. This includes an anatomical hour-glass stomach, organic pyloric or duodenal stenosis and the frequent deformities along the lesser curvature of the duodenal bulb, which are due to shrinkage and are irreparable.

We may mention here that no pharmaceutical or dietetic treatment was combined with roentgen treatment of these cases; the most harmful articles only were eliminated from the diet.

#### PROBLEM OF ROENTGENOLOGICAL, INTERNAL OR SURGICAL TREATMENT OF GASTRIC AND DUODENAL ULCERS

Surgical treatment should be resorted to only in case of complete failure of all conservative methods. This is entirely in accordance with leading surgeons (*v. Eiselsberg, Friedemann*), who consider operation and resection merely as makeshifts so long as we do not know the etiology of this disease, and admit that in a number of cases even the most extensive resection does not guarantee freedom from discomfort and recurrence. At any rate, the following conditions do belong to surgery: (1) Stenosis following scar formation; (2) profuse hemorrhage, which cannot be stopped by any other means, including irradiation of liver and spleen; (3) ulcers which are suspicious of malignant degeneration. (Niches of the size of a walnut or larger are always suspicious of developing malignancy.) A sharp line cannot be drawn between indication for roentgen-ray treatment or other medical management. The latter should always be tried first. If it does not produce results quickly, one can proceed to irradiation therapy any time. Whether or not protein therapy, which has lately been propagated

very extensively, will prove to be a competitive method, is yet undecided. An attempt with roentgen-ray treatment cannot be considered as a loss of time. As stated, the first series of treatments decides whether or not a result can be expected. If symptoms and clinical evidence remain unchanged for four weeks, deep X-ray therapy may be discarded as hopeless, and, so far, we have the impression that cases with extensive perigastric and periduodenal changes are unfavorable for irradiation.

#### IRRADIATION OF ULCER PATIENTS FOR POST-OPERATIVE DISCOMFORT

Our first observation was that of an anastomosis following radical resection of a carcinoma, which did not function at all well. It became normally patent under prophylactic post-operative deep therapy, administered to prevent a recurrence of a carcinoma. Since that time, twenty-two malfunctioning gastro-enterostomies have been treated; fifteen improving to normal function and complete or very considerable relief of discomfort, the rest, at second operation, showing mechanical obstructions. This and the fact that a result in such a case occurs within a few days after irradiation, leads to the conclusion that functional disturbances (spasms causing malfunction), may be readily relieved; other causes of insufficient patency, unsuitable position, adhesions, etc., of course do not respond to such a method.

From the large percentage of our results we draw the conclusion that spasms are a rather frequent cause of insufficient patency of an entero-anastomosis and possibly predispose to peptic ulcer of the jejunum. While they usually disappear under irradiation, we have the impression that such a peptic ulcer itself apparently is resistant against any conservative treatment. We have irradiated three patients, apparently curing one, but not improving the remaining two, one of whom died within two months, of hemorrhage.

Regarding our good results with ulcers not operated upon, and post-operative complaints, we have advised post-operative prophylactic deep therapy to eliminate spasms and possibly to check hyperacidity.

#### CONCLUSIONS

(1) Roentgen-ray therapy is a very efficient conservative remedy in the treatment of gastro-duodenal ulcer, and worth consideration in general practice.

(2) The study of the semiology of the ulcer following treatment adds interesting points to the understanding of some peculiarities, their mutual relationships, and perhaps the etiology of the disease.

#### TRANSLATOR'S NOTE

We received a second paper dealing with the same subject and discussing theoretically the influence of the roentgen rays upon benign diseases of the gastro-intestinal tract. Because of the uncertainty of the etiology, especially of the ulcer, an unbiased opinion concerning the theoretical basis of cures of such diseases cannot be found. The authors, however, believe that spasmolysis is the essential effect of the rays, to which, in all probability, may be added an influence upon the pathologically changed blood vessels of an ulcer-bearing stomach (Ricker) and possibly a depression of the glandular function. These effects are assumed to be brought about by direct influence upon the irradiated tissues. Roentgen-ray therapy accordingly is considered to be a causal (etiological?) treatment, not only of the single ulcer, but of the organo-constitutional disease.

The authors' technic is as follows: Large field to front and back of epigastrium: 30 cm. f.s.d.; 0.3–0.5 mm. Cu. or Zn. filter; one-fourth to one-third of a "tolerated skin dose" (*Hauttoleranzdosis*) to front and back twice (four exposures on four successive days). Such dosage is sufficient and

does not cause radiation sickness nor any local or general reaction.

We refrain from translating or abstracting this paper extensively because it is

mainly hypothetical and does not bring about any clearer understanding of the phenomena of roentgen-ray action and its physiology.

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# RADIO-ACTIVE SUBSTANCES AND THEIR THERAPEUTIC USES AND APPLICATIONS

## RADIOTHERAPY OF CANCER OF THE UTERINE CERVIX

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### V. VARIOUS TECHNICAL APPLICATIONS OF RADIUM IN CERVICAL CANCER

THE treatment of cervical cancer by radium now ranks as the most important application of this element to therapeutic uses. Though the past few years have seen a gratifying trend toward standardization of technic, there is still a wide divergence of opinion as to the best methods of applying radium to the malignant cervix, and the practice in the best clinics yet differs considerably in many important particulars. It has, therefore, seemed wise to review the work which has been recently reported from medical centers, giving especial attention to radiotherapy of cancer of the cervix uteri, and to bring out, by comparison, what are generally regarded as the prime essentials to satisfactory radium therapy of this disease.

All of these clinics suffer from the same disadvantages in regard to selection of cases,—the common experience of radium therapists since the initiation of the treatment. These are, chiefly, the advanced stage which the majority of women allow the malignant lesion to reach before seeking medical advice, and the fact that cervical cancer, which is potentially curable when it first comes under treatment, has been so generally turned over to the surgeon that we have not as yet any appreciable number of cases which have remained cured by radium alone over a long enough period to furnish statistics of any value. Therefore, it is still quite impossible to make any just comparison, not only between the relative merits of surgery and irradiation, but also between the merits of different methods of applying radium. The greater success which may seem perhaps to attend one method rather than another, can hardly be evaluated as more than a

“straw which shows which way the wind blows.”

Among the earliest workers in this branch of therapeutic endeavor, and one who has been increasingly enthusiastic throughout the fluctuations in the general esteem in which radium treatment has been held, is Howard A. Kelly, of Baltimore, whose work—first at Johns Hopkins and later in his own gynecological hospital—has served as a standard of attainment for similar institutions throughout the country. A detailed account of the method of procedure followed by Dr. Kelly and his associate and successor at Johns Hopkins, Curtis F. Burnam, was published three years ago, and last July in *RADIOLOGY* the work was again reviewed by Burnam and Neill. Radium emanation has now been used exclusively in their work for a long period, the emanation being placed in a bulb or small tube, which in cervical cases is enclosed in a rubber finger cot with string attached. The tubes are placed in cotton applicators and, to avoid injury to the bladder or rectum, elliptical pieces of lead, about 7.5 mm. thick and covered with gauze, are interposed between the radio-active center and the vaginal wall. In a cancer limited to the cervix, one tube is placed at the internal os, one at the external os, and four on the cervix. This gives a total of 3,000 mc. hours' radiation, divided into 1,200 mc. hours in the cervix, and 1,800 mc. hours outside the cervix. It is applied as a single curative dose, which is regarded as preferable to “broken dosage.” Frequently, 3,000 mc. hours of radium emanation in tubes is used, so as to complete the treatment in one hour. “Where smaller amounts of radium are used and longer times employed, a somewhat greater millicurie or milligram hour treatment is

necessary—perhaps a third more, where 100 mc. or mgr. is the amount of radium or emanation used. Where the parametria are involved, the exposure should be increased four or four and a half gm. hours. For extensions on the vaginal wall, about three-quarters gm. hour, evenly spread out, should be used for each square 2.5 cm. of surface, in addition to the cervical treatment indicated."

At present, when applying radium as a preliminary to operation, these therapists give one gram hour in the cervical canal with tubes in tandem from os to os, and one gram covering the entire cervix. When radium alone is relied on, they give three and a half gram hours in a single treatment, applied so that the cervical canal receives one gram hour and the surfaces of the cervix and vaginal fornices receive two and a half gram hours. "As a rule the treatment is given without anesthesia with the patient in the knee-chest posture, which permits of accurate placement of the applicators and the interposition of thick lead and gauze screens between the radium and vaginal walls." The single dose is preferred to the broken dose method as it seems "to give equally little upset, admits of much more accurate placement, and takes less radiation; i.e., the broken dose method requires one and a half times the amount of a single dose treatment." In borderline cases where operation cannot be considered, radium is used in the manner just described, with the addition of "a strong emanation point implanted centrally into the involved parametrium. Great care must be taken in sterilizing the vaginal wall. The needle should be introduced into the mass under guidance by the finger in the rectum," the finger being withdrawn as soon as the emanation point is ejected from the implanting instrument.

A year ago George Adams Leland, jr., made a report to the American Radium Society on the work done at the Huntington Memorial Hospital in Boston. Up to about 1920 all carcinomata of the cervix uteri were treated at this institution by small

fractional doses of screened gamma radiation. These applications, which ranged up to 5,000 mc. hours per treatment, were made directly into or against the cratered cervix, and were repeated at intervals of about three to six weeks. This method of procedure was abandoned for the following reasons:

"After the third or fourth treatment there invariably occurred so much reactive edema that from then on it was difficult to determine how much of the induration present was malignant disease, and how much was purely inflammatory. Accordingly, in most instances, the criterion for ending a series of treatments was the inability of the patient to come to the hospital, rather than any definite estimation as to the local condition. The local tenderness always increased progressively, so that the later treatments were very painful. Likewise, a certain amount of contracture, which inevitably took place at the apex of the vagina after the first few treatments, rendered it impossible at subsequent applications to bring the radium into accurate approximation with the main focus of disease."

These considerations led to the substitution of the single massive dose method, the application being made under a brief gas or gas-ether anesthesia. Unscreened radium emanation is used, the dosage in the most favorable cases averaging 5,000 mc. hours per individual treatment. "This total has been about evenly divided between emanation seeds left buried in the cervical tissue, and emanation tubes enclosed in steel jackets, placed in the utero-cervical canal for a maximum of eight hours. In other words, for a treatment of 5,000 mc. hours, emanation seeds totalling 18 to 19 millicuries have been implanted, and steel-encased tubes totalling 300 to 800 mc. have been inserted for from three to eight hours. Small doses for long periods have been observed to produce more nausea than large doses for short periods." Though larger seeds were used at first it is but rarely that they are now implanted of

over one and a half to two millicuries each, "using a sufficient number to make up the required total. In order to further safeguard against fistulæ because of too deep implantation, each cervical trocar is made with a bulbous attachment one-half to one centimeter from the tip. This acts as a safety wedge when the instrument is thrust into the tissue. The strength of the steel-encased emanation tubes has varied from 2 mc. to 300 mc. each. It is preferable to use the largest tubes available, as it is difficult to place accurately over five or six bare tubes within the utero-cervical canal." Patients are kept in the hospital for two nights after treatment and advised to refrain from all exertion for a week, and active labor for a month. Repetition of the heavy unscreened treatment has not been found effective, except in rare cases.

The work of the Cancer Institute at Buffalo was described to the New York State Medical Society in April of last year. The treatment was not standardized there until 1920, when the use of radium emanation was begun. The filterage since then has consisted of silver  $\frac{1}{2}$  mm., brass 2 mm., rubber 1 mm. Tandem tubes are introduced into the cervix for periods of 1,000 to 1,500 mg. hours per tube. Radium packs are employed externally, placed at 6 cm. distance, filtered with brass 2 mm., silver  $\frac{1}{2}$  mm. and 1 cm. rubber, the whole giving a depth dosage of about 17 per cent of the erythema dose at 10 cm. depth, distributed over two to four fields on the pelvis—anterior and posterior. Lysol douches—one teaspoonful to two quarts water—are given shortly before the radium is to be introduced, and a small amount of nitrous oxide and oxygen administered so that the introduction may not be attended by pain. The day following the radium application, high voltage X-ray is employed externally through two or four fields—depending upon the thickness of the patient—the intention being to administer 80 to 90 per cent of the skin dose, in the region of the cervix and broad ligaments. The conditions under which X-ray is given are 200,-

000 volts, 80 cm. distance, with the time factor depending upon whether two or four fields were used in order to secure the desired depth dose as shown by charting off each individual case.

Patients are kept in the hospital for two to four days, "not being discharged unless they are free from temperature and apparently in good condition." The average length of time for the healing process is from two to four months.

Of the institutions in New York City giving especial attention to radium treatment of uterine malignancy, there have been a number of different reports recently given out. Dr. Lillian K. P. Farrar gave an account of the work at the Woman's Hospital at the meeting of the New York State Medical Society last May, the report including her private patients as well as those of her chief, Dr. George Gray Ward. The preparation and dosage were described as follows: One hundred milligrams of radium in a glass capsule are placed in a silver tube, which is, in turn, placed in a brass container, 1 mm. in thickness. This brass tube when ready for use is encased in a rubber tube, the open ends of which are securely tied with two strands of braided silk. These silk strands are joined to others which have been previously drawn through the eyelets in the brass tube, to ensure its recovery in case the rubber tube should be torn during the process of removal. One strand is attached to the gauze which packs the vagina, and threaded into a needle which is pushed through the cervix and then brought out through the packing and fastened outside the vulval orifice. The initial dose of radium is 100 milligrams in a single tube, left in the cervix for twenty-four hours, or—in women under thirty years old—for from thirty to thirty-six hours. "If at the end of eight weeks from the first radium treatment a pale cicatrix has not formed or healing is not definitely progressing, a second radium treatment is advised." A third or even a fourth dose is occasionally given, if it is deemed necessary.

The radium technic employed at the New York Post-graduate Medical School and Hospital is now carried out along the lines laid down by the late George Stuart Willis, former director of radium therapy. The method of employing radium in connection with surgery in malignancy of the uterine cervix has been recently described by Dannreuther, whose avowed preference is for needles containing salts of radium, rather than emanation "seeds," and who also believes "that it is wiser to use what may be termed a moderate dose in tubes frequently repeated, for the pre-operative uterine applications, rather than to use a massive dose at one sitting." Simultaneous biopsy and radium application are carried out, six 5 mg. platinum needles being thrust directly into the carcinomatous tissue, making it "possible to distribute the radium rays from the growth itself . . . [and] . . . produce homogeneous cross-firing over a wide area." The needles are left for twenty-four hours, giving a total of 720 mg. hours' dosage. This is regarded merely as preliminary treatment, until the existence of malignancy is positively established. If carcinoma is found to be present, a 50 mg. tube of radium is placed in the upper limit of the uterine cavity (deep fundus) and left for twenty-four hours. A few days later the same tube is introduced only so far as the center of the cavity (mid-portion) and left for twenty-four hours. After the lapse of another few days the tube is inserted in the cervix for twenty-four hours. Another twenty-four-hour application to the cervix is made at the end of four or five weeks. At each radium application the vagina is carefully packed and the bladder kept empty by the use of an indwelling catheter. The complete course of pre-operative radium treatment amounts to 5,520 mg. hours. Attention is called to the fact "that applications to the vaginal vault are not included in the pre-operative treatment; they are of course essential in cases where radium therapy exclusively is relied upon for cure."

Following panhysterectomy, "as soon as the line of union in the resected vaginal walls is firm, 50 or 100 mg. of radium is placed in a lead container (closed on the ends and three sides), directed toward the parametrium, and left for twenty-four hours. Three months later this treatment is repeated. After another three months the vaginal roof is usually found so atrophied and contracted that it will not accommodate the radium applicator. In such cases, 100 mg. of radium or high voltage X-ray is used externally. This cross-firing is carried out again in another three months. During the second and third post-operative years, treatments are given every six months."

The plan of radium treatment devised by Harold Bailey, in 1918, is still followed, with some slight modification, at the Memorial Hospital in New York City. This consists in intensive cross-firing of the cervical lesion and the surrounding pelvic structures, from the cervical canal, the vagina and the external surface of the body. At first the entire treatment was carried out by the use of radium only, but in 1921 the external use of radium was supplanted by low voltage roentgen-ray exposure, "as this was found to facilitate the treatment of the cases and to give us, in conjunction with the internal application of radium, a greater percentage of effective irradiation in the deeper pelvic areas." From seven to ten days is the time consumed in treating each patient. "This means that primary cases, on the average, will have received 6,000 millicurie hours' radium treatment, of the gamma ray type, in and about the cervix, and four roentgen-ray applications in that time. The routine roentgen-ray treatment consists of a fifteen-minute exposure with 5 mm. aluminum filter, 12-inch focal distance, 10-inch spark gap, from 90 to 110 kilovolts, and 5 milliamperes of current. The tube is so arranged that the rays converge toward the center of the pelvis, and the areas treated are right and left iliac anteriorly, and right and left sacral posteriorly. The cross-



firing with radium is carried out by means of radium capsules inserted into the cervical and lower uterine canal in tandem arrangement, and by the use of the so-called bomb applicator, holding a gram [(one curie meant): parentheses mine] of radium emanation, in the vaginal canal directed toward the right parametrium, for 1,000 millicurie hours in each position. In the early cases this internal application of radium was supplemented by external application in six positions about the pelvic girdle."

At the Mayo Clinic, the method employed is described as "an initial, intensive, fractional application of the therapeutic rays of radium to single or multiple malignant neoplasms, primary in the cervix uteri, with or without involvement of the vaginal walls. The anterior, and in some cases the deep portions, of the uterine body are treated. This is supplemented by a course of high voltage roentgen-ray treatment."

The fractional or "broken dose" method is considered preferable at this clinic. The diseased area is arbitrarily mapped out into three equal treatment divisions, each representing a length of about 2.5 cm. and a total of 7.5 cm.—the average depth of the cervico-uterine canal. A universal silver tube applicator, 0.5 mm. thick, containing 50 mg. of radium, is used, and several of these tubes can be placed in a vaginal applicator, the outside dimensions of which are 17 mm. in diameter with a total length of 4 cm. This applicator is of brass, 1 mm. thick, encased in 2 mm. of hard rubber. A tandem applicator is also used, made up of three universal applicators, held in place by a rubber case, 1 mm. in thickness. Tight vaginal packing holds the applicators in place, so that the lead protectors formerly in use have now been abandoned. At least four treatments are separately administered, at the rate of two a week. An interval of from four to six weeks is then allowed to elapse, this being followed either by radical operation, or a completion of the full course of radium therapy, supplemented by deep roentgen-ray applications. Though it has been

found necessary to individualize each case, in general, the Mayo Clinic technic may be said to require the delivery of at least 3,000 mg. hours to each of the treatment areas before indicated. Two applications a week are given by the broken dose method, the number varying from four to ten, or in bulky medullary tumors even to twelve or fourteen. As soon as the uterine canal can be probed, the tandem applicator is inserted. "Should the canal fail to open, the cervical treatments are discontinued, and the vaginal applications given. At each vaginal application, new areas are sought, and, if found, are treated at the next application. This feature is one of the chief and most important factors of the broken dose method." Deep roentgen-ray treatment follows the completion of the radium exposures.

The methods employed in our own clinics here at home follow closely those used in England and on the continent of Europe, where, in the great majority of instances, the technic was first instituted. The work of Hayward Pinch at the London Radium Institute is probably typical of what is being done in many parts of Great Britain. This therapist still believes that "early performance of Wertheim's hysterectomy in skilled hands, followed by a thorough course of radiation," is to be preferred to radiation without surgery, but, nevertheless, he relies on radium for those numerous cases where surgery is sought too late. In the endocervical or medullary type of growth he employs a tube of 100 to 150 mgrs., screened with 1 mm. of silver, which is left in the cervical canal for twenty-four hours. "This should be supplemented with one or more tubes of 25 mgrs., screened with 0.3 mm. of platinum, and inserted into the thickened cervical walls, or into the nodular infiltrations in that situation. The exposures here should be of twelve hours' duration. If definite infiltration of either or both of the broad ligaments be present, a radium tube, or tubes of 50 mgrs. activity, screened with 1 mm. of silver, should be inserted into the infiltrated area,

an exposure of twenty-four hours' duration being given there." In addition to the foregoing a general irradiation of the pelvic cavity should be carried out by means of flat applicators containing 150 to 200 mgrs., screened with 2 mm. of lead and applied immediately above the pubes, and in each iliac fossa. The exposure here should be from twenty-four to thirty hours' duration, and it is advisable to move the applicators slightly from time to time, in order to avoid the possibility of skin vesication. In the flattened ulcerated type of lesion treatment is by small 25 mgr. tubes, screened with 1 mm. of silver, kept in contact with the ulcer by means of a mold of dental modelling compound, which is held in place by gauze packing. In dealing with the cauliflower type of lesion, as much of the growth as possible is first cut away, after which the remainder of the cervix is treated by the insertion of a 100-mgr. tube, screened with one mm. of silver, into the cervical canal for twenty-four hours.

Much valuable work on radium treatment of cervical cancer has been done at "Radiumhemmet," in Stockholm, a hospital designed solely for radium treatment of malignant disease. Reports of this work have been published in the English language by Heymann and Westman, covering the period from 1914 to 1922. "The treatment has been either vaginal radium radiation alone, or with heavily screened preparations, or a combined radium-roentgen treatment, or percutaneous or vaginal roentgen irradiation alone. The radium treatments have been applied by means of tubes containing radium bromide. The rays have been filtered through three to four mm. of lead. The tubes have been applied

in the vagina during the treatment. The doses have, on an average, corresponded to fourteen centigrams of radium bromide, and the duration of the treatment has been about twenty hours." The roentgen treatments have been applied in series. Generally, four fields of entry have been employed, two anterior and two posterior, the endeavor being to deliver an erythema skin dose. A copper filter, 0.5 mm. thick, is now used, the focal distance being 20 to 24-30 cm.

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## SOME OUTSTANDING PHYSICAL CONSIDERATIONS IN RADIUM AND ROENTGEN THERAPY<sup>1</sup>

By DONALD C. A. BUTTS, F.A.I.C., Research Assistant in Roentgenology and Radiology; Department of Materia Medica and Therapeutics, Hahnemann Medical College and Hospital, PHILADELPHIA

WHEN considering the cancer problem from the viewpoint of the investigator, we realize that we are not dealing with merely a definite and fatal pathologic entity, but with a complex physical and chemical, or, more accurately stated, bio-physical, bio-chemical and physico-chemical alteration, of which the ultimate point is manifestly histologic and metabolic in character.

It is indeed true that a section taken from a mass may distinguish its benign or malignant characteristics, even act as a guide for surgical or radiological intervention, but it offers little or no light upon the problem of etiology. Such a basic problem as this has, to the present time, evaded the powers of the microscope and the test-tube; its origin is apparently beyond the scope of these tools of the investigator.

In view of this deduction we are forced to consider what change of a more basic nature underlies and precedes chemical action and reaction, and in so doing, we are brought into the realm of physics, the basic science.

We may, therefore, take as our working basis that, for an organized structure to take on abnormal manifestations, the change must be, first, atomic, or physical; secondly, molecular, or chemical, and lastly, if the two former alterations are maintained, histological.

We of the present day know that all matter,—and this naturally includes our bodies, each cell, and subdivision of each cell,—is definitely composed of atoms, which, in turn, are further subdivided into definitely electrified particles.

The clinician may ask, in what way atomic structures, mechanism and energy enter into the study of neoplasia; how such a purely physical phenomenon is related

to a physiological or pathological process. He will, however, grant that the subject of radio-activity is dependent upon atomic disintegration, and that the phenomena of rays and radiating sources have been placed upon a strict scientific understanding only with the increased knowledge of atomic structure. Therefore, the answer to the question is indeed obvious, for the two are so closely related that they must be considered upon the same fundamental basis.

Let us, before going further, systematically deduct and formulate the reasoning set forth in this report, that the action of rays and radiations upon cell metabolism may be clearly understood.

First: The complex mechanism constituting our bodies is composed of nothing more or less than cells, each unit cell functioning to carry on life's processes. When harmony between these units is maintained, health results; when disturbed or altered function is brought about, disease, in one form or another, results; when dynamic force no longer exists, metabolism ceases and bodily activities are brought to a close, demonstrable to us as death. This would mean that it is not until all dynamic elements are brought into a state of equilibrium that death, in the full sense of the word, would result. Here we must differentiate between death of an organism and cell death.

Second: Each unit cell has its definite composition of colloidal and crystalloidal nature, in definite amount and balance.

Third: These colloidal and crystalloidal components of the cell are definite chemical substances, capable, to a great extent, of chemical analysis. Thus each cell is an aggregate of chemical molecules.

Fourth: Each chemical molecule, regardless of its combination or locality, is

<sup>1</sup>Read before the Eastern Homeopathic Medical Association, Springfield, Mass., October 14, 1925.

composed of constituent elements, definitely and accurately balanced to form the molecule.

Fifth: Each element is further subdivided into its constituent atoms.

Sixth: Each atom of an element is composed of a definite and regulated number of protons and electrons, *i.e.*, positive and negative ions. The ratio of protons and electrons is constant in each atom of the same element, and from this ratio is obtained the atomic weight and number of the element in the Periodic System. This will be explained at a later point.

Seventh: Each proton is a unit of positive electricity.

Each electron is a unit of negative electricity.

From the reasoning just formulated, we are convinced that life with its processes is, in its continuance, a complex and elaborate scheme of colloidal chemistry which has for its basis a fundamental physical, electrical, or dynamical force. As the subject of neoplasia deals primarily with stimulated cell reproduction, thus increased metabolism of cell life, the bio-physical basis of our problem, seems inevitable and certain, and we are justified in considering the problems of cause and effect from this point of view. If we place cause and effect upon a foundation, as just outlined, we must naturally consider the action of any agent causing alteration and repair as being upon a similar basis. When we further consider that, when employing rays and radiations from radio-active bodies and from the roentgen tube, we are dealing with nothing but purely physical agents, the whole problem of neoplasia and therapy becomes greatly simplified, and the outlook is indeed more hopeful.

Now that I have attempted a physical or physico-chemical interpretation of cell metabolism and life, I shall briefly consider the physics of rays and radiating sources, and later combine the two explanations in an attempt to explain the various effects of radium and roentgen rays upon normal and abnormal cell structures.

There are, as you know, two forms of radiation, *i.e.*, spontaneous (as from the radio-active elements: uranium, thorium, and actinium, and their disintegration products), and those generated from the discharge, or roentgen, tube. In spite of the dissimilar origin, their physical characteristics are strikingly similar, and to a great extent identical; for in both instances there are three forms or varieties of rays emitted: one of electro-magnetic character (gamma and X-rays); the other two, of corpuscular nature (one of positive character, the alpha particles of radium, and the canal or positive rays of the roentgen tube; the other negative in charge, the beta particles of radium, and the cathode rays or electrons from the roentgen tube).

The three forms of radiation just mentioned differ materially in physical, chemical, and biological effects, and to understand their action requires, first, a knowledge of certain physical laws and interpretations.

First, let us consider the difference between electro-magnetic waves such as gamma and X-rays, and rays of corpuscular nature, *i.e.*, the alpha and beta particles.

The outstanding physical difference, aside from wave length, penetration, etc., is, that the former (gamma and X-rays) are devoid of any electrical charge, whereas the latter (alpha and canal rays, beta and cathode rays) are definitely charged particles, the two former being positively charged while the latter are negatively charged. This being the case, the gamma and X-rays remain unaffected while passing through a magnetic field, whereas the alpha and canal rays are deflected toward the negative pole, while the beta and cathode rays are bent toward the positive pole.

We shall now proceed to analyze the different rays to the best of present-day knowledge.

First, let us consider the alpha rays. These are positively charged helium atoms. By this we mean a helium atom which has been deprived of its planetary electrons. Under normal conditions the helium atom,



like all atoms, is a balanced entity, composed of protons and electrons, enough of each to form an electrically neutral atom.

In all atoms there are sufficient negative electrons to balance the positive charge of the nucleus. Some of these electrons are within the nucleus, while the remaining ones revolve about the nucleus in planetary motion. Thus in the helium atom, which consists of 4 protons, or positive charges, there are 4 negative electrons; 2 intranuclear, and 2 peripheral electrons. In the case of phosphorus, whose atomic weight is approximately 31 (31.04) and whose atomic number is 15, there are 31 protons, 16 intranuclear electrons, and 15 peripheral electrons. Uranium, with an atomic weight of 238 (238.17) and an atomic number of 92, consists of 238 protons, 146 electrons within the nucleus, and 92 electrons of planetary position.

As can be seen from the above examples, it is the number of protons in the atom which endow the elements with their respective atomic weights, for these protons are simple hydrogen nuclei and, as we know, the atomic weight of hydrogen is unity.

The number of electrons in planetary motion about the nucleus of the atom determine the atomic number, or its position in the Periodic Table of Mendeleeff. These electrons, although comparable in size to the protons, are 1,830 times lighter, or less massive. Thus it can be seen that the loss of an electron would not exert a negligible influence upon the atomic weight of an element, but would affect its atomic number to the extent of the number of electrons lost during any radio-active transformation. Therefore, were the helium atom to lose a planetary electron it would become a helium ion, with one elementary quanta of electricity; consisting of a nucleus of 4 protons and 2 electrons, and one planetary electron, however, its atomic weight would still remain 4. If the helium ion were to lose its remaining planetary electron, the atomic weight would still remain unaltered, and we would have an alpha particle, with

two elementary quanta of electricity; a mere nucleus composed of 4 protons and 2 electrons. This structure is decidedly smaller than the helium atom but larger than the hydrogen atom. It is possessed of a powerful ionizing property but a very low penetrating power, its greatest range in air being 8.6 cms., and it can be entirely absorbed by 0.006 cm. of aluminum.

Knowing the structure of the alpha particle, we are able to understand why any radio-active transformation involving the emission of an alpha particle reduces the atomic weight of the resultant disintegration product by 4 (Fig. 1).

The beta rays, or particles, are electrons, or compact masses of negative electricity with a mass of  $1/1830$ th that of the alpha particle. Due to their mass they have a greater penetrating power than the alpha particles, but a reduced ionizing capacity.

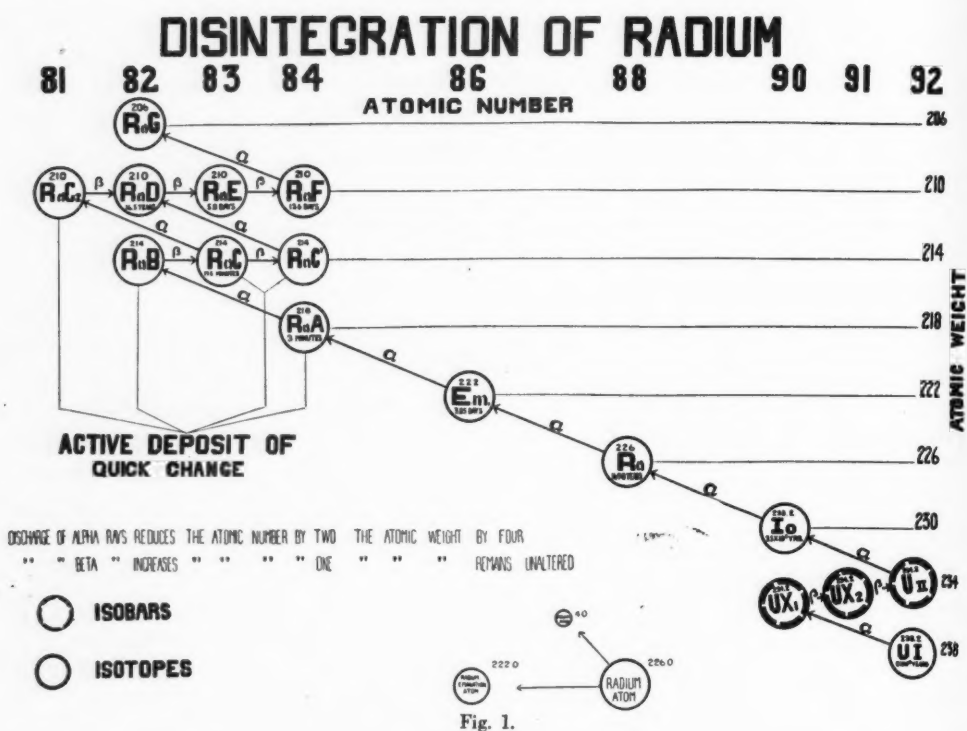
The gamma and X-rays are, as stated before, electro-magnetic vibrations of the ether, devoid of any specific electric charge, and remain unaffected by any magnetic field obtained to the present time. These rays have a great penetrating power and are able to produce their ionizing effects after passing through several centimeters of lead.

Let us now consider in what manner these various rays are generated, and their ultimate effect upon bodies exposed to their influence.

To cover this subject in detail would require a work of considerable length and involving complex theories and calculations, so we will here merely outline the phenomena, avoiding all the elementary explanations leading to the points to be formulated.

When cathode rays (moving negative electrons) strike matter, X-rays are produced; this is the principle of the roentgen rays. The X-rays, so formed, upon striking matter, give rise to a series of phenomena. First of all, the atoms of the bombarded structure are deprived of constituent electrons, thereby being rendered posi-





tive ions until the necessary compensating electrons are re-supplied, to return them to neutral atoms. In this physical phenomenon we find ready explanation for the stimulating effects of gamma and X-rays, even to the development of pathologic cell change.

The primary X-rays themselves undergo a series of alterations upon collision with matter, for a certain percentage of the original beam is broken up into scattered, characteristic, and corpuscular rays; or, in other words, into X-rays, rays characteristic of the substance bombarded, and cathode rays or negative electrons. Therefore, the greater the thickness of the material exposed, the greater the phenomenon of ray disorganization. This point is one of great and outstanding importance in the therapy as employed in the Department of Roentgenology at the Hahnemann Hospital in Philadelphia, and is also one of the causes of fogging and lack of definition of roentgenograms of the abdomen.

The mechanism just outlined brings us to the consideration of Matter and Energy being interchangeable, and thus to the Theory of Relativity. However, this will not be considered in this report.

As to the mechanism and energy of intra-atomic structure we will here cite only the experiments of St. Meyer and Hess, which demonstrated that one gram of radium emits heat at the rate of approximately 132 calories per hour, thus showing that energy (in the form of heat) is constantly given out by radio-active bodies. With the expulsion of an alpha or beta particle, there results an alteration within the atom and the liberation of energy, manifested as gamma radiation. This process is continuous throughout the life of the element.

Once outside the atom, this energy, demonstrable as gamma radiation, undergoes disorganization upon its encounter with matter. Part of the gamma rays continues as such, while a portion goes on as secondary radiations of beta or negative type.

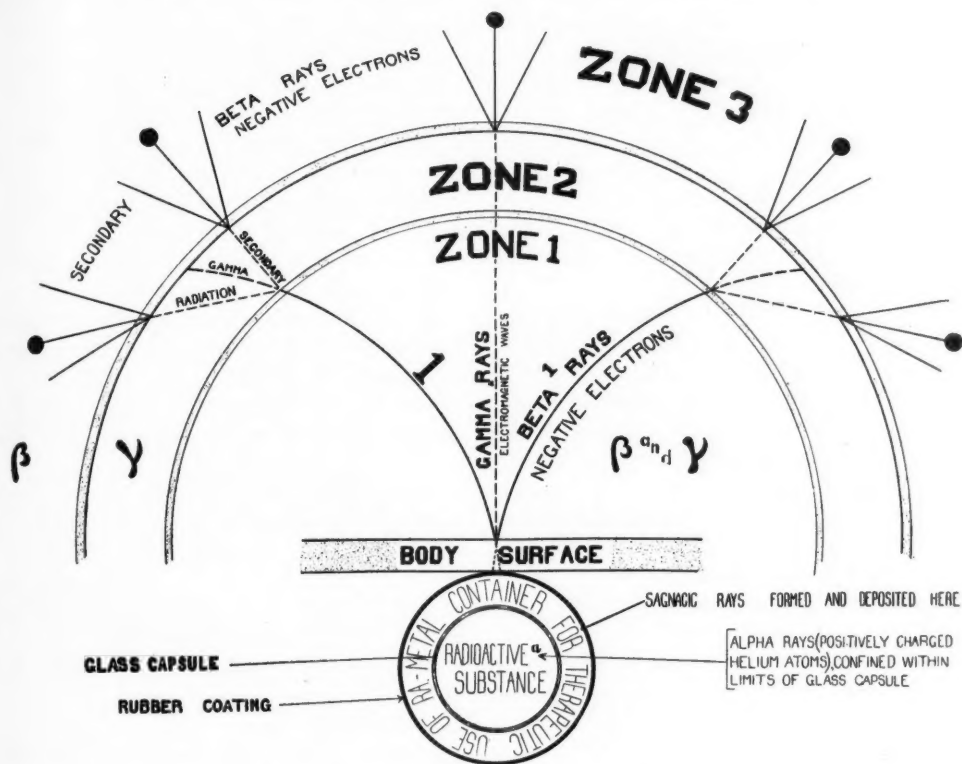


Fig. 2.

The effect of gamma rays upon matter is the same as produced by X-rays, i.e., splitting off electrons from the atom, thereby rendering the formerly neutral atom a positive ion.

Beta or cathode rays, upon traversing matter, give rise to secondary gamma rays, and these, upon further penetration, give rise to a tertiary radiation of negative type. This cycle of events, if continued, will eventually result in the formation of negative electrons, no longer capable of further propagation (Fig. 2).

We shall not continue further into the technicalities of our subject but now formulate our reasons for utilizing the negative electrons in the treatment of malignant pathologic processes.

At the beginning of this paper we formulated the atomic basis for cell life and metabolism, and found that we couldulti-

mately view the cell as a mass of protons and electrons, of positive and negative ions.

We have analyzed briefly the rays and radiations from radio-active bodies and from the roentgen tube and found that, regardless of the initial type of radiation employed, the ultimate result is the formation of negative electrons, either primary or secondary.

We know from physical research that if a gas placed between two metal plates be ionized and a difference of potential be established between the plates, the positively charged ions travel toward the lower potential and the negatively charged ions toward the higher potential.

Repeated animal experimentation with standard strains of laboratory tumors has demonstrated neoplastic tissue to possess a greater or higher potential than does normal tissue. Therefore it is evident that

before any chemical or histological alteration and repair can be brought about, it is first necessary to adjust this bio-physical alteration, and the readily accessible tool is the negative electron.

Aside from the experimental evidence of this bio-physical alteration of neoplastic tissue, there are several theoretical reasons tending to prove that such an alteration should exist.

The first illustration is seen in the fertilization of the ovum. This condition is brought about by the addition of the sperm head, which through physico-chemical analysis has been found to be electro-positive in reaction. Considering the ovum a physically balanced cell (as are all normal, resting, and adult cells), it is easily seen that upon the addition of an electro-positive agent the ovum can no longer remain a balanced cell and, as nothing but the sperm head has entered into the process of fertilization, it is our only conclusion that, at this period, the ovum is strongly electro-positive as compared to its normal state, or, in other words, possesses a greater or higher potential than under normal conditions.

Experimentation by the writer has proven embryonal tissue to show the same bio-physical characteristics as does neoplastic tissue but to a more pronounced degree. When we consider the comparative rate of proliferation of the two forms, this observation is readily understood.

Our second illustration is one familiar to every pathologist, *i.e.*, the staining properties of the cell. Here, the nucleus, which is electro-positive as compared to the cytoplasm, has an affinity for the basic dyes, whereas the cytoplasm takes up, to a lesser degree, the acid stain. It is hoped that through a careful study of the staining properties upon frozen sections of normal, pathologic, and irradiated cells, using various electro-positive and electro-negative dyes, that this experimentation may be substantiated and utilized by the pathologist.

The third illustration, which is an entire-

ly new conception, is that of the stimulating effects of gamma and X-rays.

At an earlier point the fact was mentioned that gamma and X-rays, upon bombarding atoms, cause the expulsion of constituent electrons, thereby rendering the formerly neutral atom a positive ion. This state of affairs is also brought about by alpha and beta particles upon their collision with an atom.

In an earlier paragraph it was brought out that our bodies may be viewed as huge aggregates of chemical molecules, which molecules are further subdivided into constituent atoms, these into protons and electrons.

It is indeed reasonable to assume that these atoms, when subjected to radiation, are disturbed in the same manner as are atoms of crystals used for the study of atomic structure and physical phenomena, for an atom is always the same, regardless of its locality or combination, and is subject to the same laws of cause and effect under all conditions.

If such a physical change as just outlined is brought about within the atoms comprising our cell chemistry, it is readily seen that tissue exposed to short and repeated doses of spontaneous or induced radiation could no longer exist as a normal cell, due to the loss of some constituent electrons, and would therefore be in an electro-positive state of physical unbalance as compared to tissue from which no electrons had been expelled (Fig. 3).

It was also illustrated at an earlier point that electro-magnetic waves, manifested as gamma rays of radium or X-rays from the roentgen tube, upon striking matter, give rise, within the material so exposed, to electron formation. However, it is necessary, in irradiating an area, that a certain amount of matter, in one form or another, be penetrated before such electrons can be liberated and utilized.

From the above reasoning it is indeed conceivable that radium and roentgen rays might produce a stimulating effect, even to the development of conditions experienced

by pioneer investigators in the fields of radiology and roentgenology; for here, superficial structures were repeatedly exposed to influences which might render the tissues electro-positive by the expulsion of electrons (Fig. 3), there being no material interposed between the material handled and the structures exposed to cause the liberation of compensating negative electrons to maintain physico-chemical balance within the cells.

In dealing therapeutically with rays and radiant energy, we realize that such forces, possessing none other than physical construction, are unable to exert their powers in any manner other than initial physical nature. This knowledge, combined with a bio-physical study of cellular metabolism, the findings of which have already been stated, have led us to realize that in all likelihood it is the negative electron alone which is of beneficial therapeutic use, and we have therefore directed our efforts and research toward determining the true action and proper handling of this valuable physical agent in the treatment of certain pathologic processes, for, regardless of the initial type of radiation employed, the ultimate outcome is the formation of these negative electrical units.

Extensive animal experimentation with gamma and X-rays, beta and cathode rays, offers some very conclusive and valuable data. Because of limitations of space our results will, at this time, merely be formulated.

First: That gamma and X-rays bring about physical alteration in neoplastic tissue only by the production of secondary radiations of negative type.

Second: That tumors exposed to beta or corpuscular radiations demonstrate a rapid reduction in potential, which is followed by biologic cell change, atrophy of the tumor mass, and apparent readjustment of cell metabolism throughout the entire organism.

Third: That gamma and X-rays find their field of usefulness as excitants to the desired radiation of beta or negative type.

Fourth: That by the use of radium emanation in equilibrium with its decay products, or scattered radiation from primary X-rays, the desired negative electrons can be readily obtained and satisfactorily

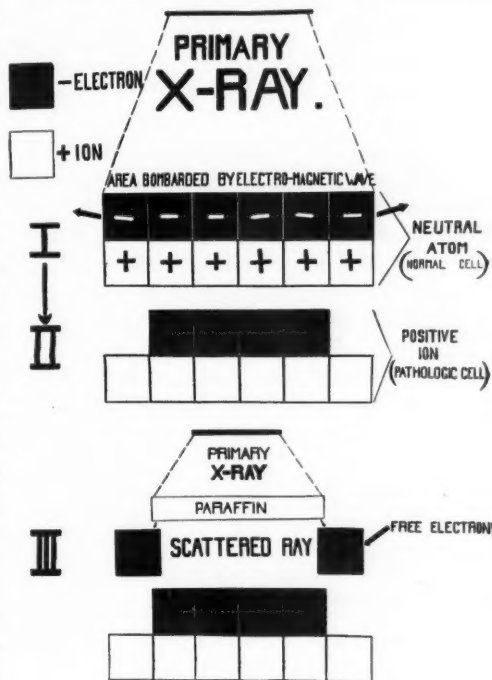


Fig. 3.

handled for therapeutic purposes, regardless of depth or position of pathology.

Fifth: That the caustic action of rays from radium or the roentgen tube is, without doubt, due to an excess of negative electrons, either of primary or secondary type.

Sixth: That by supplying to electron-deficient tissue sufficient electrons to compensate for those lost when undergoing pathologic cell change, we can, apparently, bring about a condition of normality without cell destruction and thereby arrest the advancement of the disease.

Seventh: That all pathologic change is primarily of physical nature, which, through necessity, manifests itself as a chemical or physico-chemical change. This once established, there naturally results a metabolic disturbance which is interpreted

as one condition or another by the pathologist through the aid of the microscope. The initial physical alteration once corrected by means of proper physical agents, chemical change must necessarily follow, and if the two are maintained by holding the physical balance and therefore the proper chemical combinations, metabolism must adjust itself with the ultimate outcome, again manifested to the eyes of the microscope as repair.

In concluding, allow me to say that it is only through a thorough physical study, combined with accurate animal experimentation, that all phases of our research receive their initial trial before being turned over for human application. Therefore, all clinical reports which will be presented in the papers of Benson and Frank have been preceded by gratifying results upon animals, in which case all tumors treated were given the most careful pathologic study. It was by means of experimental animals that our dosage of radium emanation implants was found safe and effective, that our method of roentgen therapy was found adequate and gratifying, but it is only in the field of human application that our end-results are interpreted.

NOTE: For the interest of the therapist reading this report, I wish to state that we have found in hundreds of cases of human and animal tumors studied,  $\frac{1}{8}$  to  $\frac{1}{4}$  mc. of radium emanation, in sealed capil-

lary glass "seeds," per sq. cm. of tissue at the surface, or per cu. cm. in the depth, to be an effective dosage. This is followed by biologic cell change, and repair, *without destruction*.

Hundreds of cases are now under treatment at the Hahnemann Hospital by this method of therapy, with good success.

In our roentgen therapy we make use of paraffin for its scattering properties and its ability to produce the required negative electrons.

Voltages varying from 80 K.V. to 100 K.V. are usually employed, and the time of exposure seldom exceeds 15 minutes (usually 7 to 15 minutes).

In cases of deep-seated pathologies, paraffin is not used, for we depend upon the penetration of tissue for our scattered radiation. The thickness of paraffin, when employed, depends upon the position and depth of the lesion to be treated, a careful study having first been made of the ionizing properties of the rays under varying filter and tube conditions.

In no case treated by this method of roentgen therapy have we observed a destructive action of the rays. The process is one of construction rather than destruction. At the time of this writing, seventy-two cases of advanced malignancy are under this method of treatment, and, with but few exceptions, the results are gratifying.



# STUDIES ON THE SUSPENSION-STABILITY OF THE HUMAN BLOOD <sup>1</sup>

## II. THE CHANGES OF THE SEDIMENTATION RATE OF THE ERYTHROCYTES IN VITRO AND IN VIVO AFTER X-RAY EXPOSURE

By ERNST A. POHLE, M.D., Assistant Professor of Roentgenology, University of Michigan Medical School, ANN ARBOR, MICHIGAN

IN a former paper (1) I have tried to show, first, that the velocity of the sedimentation of the erythrocytes gives us a definite idea of the changes of the colloidal composition of the blood; second, that exposure to X-rays causes certain changes in the suspension-stability of the blood, made evident by marked variation in the sedimentation test. It may be stated here that since the completion of that publication (November, 1924), we have continued these tests and are able to prove the statements made.

There is one question which comes up when we try to find an explanation for the reported observations: How does the change of the sedimentation rate noted in the living human body (*in vivo*) after X-ray treatment compare with tests made from blood irradiated in test tubes (*in vitro*)? Mond (2) has published experiments on the effect of ultra-violet radiation upon the sedimentation rate of red blood corpuscles, and he has seen a very pronounced influence of ultra-violet rays on this phenomenon; he explains his findings by a direct influence on the albumin in the blood. Two investigators, Mikulicz-Radecki (3) and Jaller (4), have irradiated human blood in test tubes with roentgen rays and obtained different results. The first author used 16 c.c. of blood taken from the cubital vein, mixed with 4 c.c. of 5 per cent sodium citrate solution, the mixture being divided in two parts and placed in sealed test tubes. One tube was irradiated and the other used as a control. The sedimentation rate of the treated blood was decreased as compared with the normal control. Both tubes were shaken before the reading was started. A different method was used by Jaller. She prepared

the blood in the same way, but distributed it in a number of small Sahli tubes, filling each with about 1 c.c. of blood mixture. Two tubes were kept as controls, the others were rayed. Doses from 10 to 1,000 per cent of the H.E.D. (S.U.D.), filtered through 3 millimeters of aluminum, were used. No influence of the X-ray radiation on the sedimentation rate was observed, if the controls were read immediately after filling the tubes, and the rays applied directly at the beginning of the sedimentation. Shaking the tubes after observation of the heights of the plasma layer over a period of an hour made it possible to read the reaction a second time. Slight differences were usually noted between the first and second readings. Objection is, therefore, raised to the method of Mikulicz-Radecki, who shook his test tubes before taking a reading. Both authors state that the untreated blood showed a lighter red color when shaken than the irradiated blood. Mikulicz-Radecki also compared the sedimentation rate of the blood of a patient before and after treatment with the blood of that same patient treated in a test tube. He noticed that both reactions were parallel when readings were taken several hours after the irradiation.

The discrepancy which is present in the papers of the authors mentioned has induced us to repeat their experiments. We did not try to compare the sedimentation rate of the blood of patients before and after an X-ray treatment with the same blood irradiated in test tubes outside of the body, because it is our opinion that the effect observed in its end-result as a change in the sedimentation rate of the circulating blood is of too complex a nature to be expected to run parallel to that in the stagnating blood in a glass tube.

<sup>1</sup> Received for publication August 17, 1925.

We used for our experiments the micro method described in detail in the first paper.<sup>2</sup> Two pipettes were filled at the same time from one person, one being irradiated, the other used as a control; only normal

ment of Jaller<sup>3</sup> that although the reaction is reversible, the second reading hardly ever agrees with the first test. We observed a rather pronounced acceleration compared with the first reading. It is, therefore, not

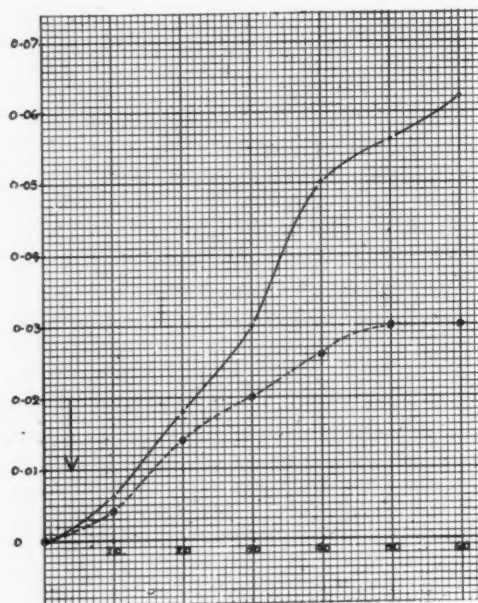


Fig. 1. Sedimentation curve. The straight line represents the control tube, the dotted line the irradiated tube. The time is given in minutes, the ordinate shows the sedimentation-coefficient. The arrow indicates when X-ray exposure took place.

individuals who had never been subjected to X-ray treatments were chosen. The character of the roentgen rays used was: 9-inch spark gap (ca. 135 K.V.), 5 ma., no filter, 30 centimeters' distance. The dose varied from 100 to 500 per cent S.U.D.

The results obtained are represented in Table I, and cover over three hundred readings done on fifteen normal adults, male and female, including a second reading of each pipette. The tests given in Column 2 were taken twice, controls have always been done and a mean value of the controls is given in Column 1. After one hour the blood in every pipette was mixed again and the whole test repeated (see figures in brackets). We can fully verify the state-

TABLE I

Person	Control	100% S.U.D.	200% S.U.D.	500% S.U.D.
E. W.	8.5 (13.0)	9.0 (16.0)	4.0 (5.0)	2.3 (6.1)
M. H.	5.5 (8.3)	5.8 (9.0)	4.5 (10.5)	4.5 (9.6)
E. S.	3.4 (4.0)	3.5 (4.0)	3.0 (5.0)	3.0 (7.4)
H. D.	8.8 (14.2)	8.0 (16.0)	7.0 (8.0)	7.0 (8.5)
W. K.	4.6 (6.4)	5.0 (8.2)	3.8 (7.6)	4.0 (8.3)
V. H.	6.0 (7.0)	6.5 (10.5)	4.0 (9.6)	6.0 (9.2)
E. D.	7.5 (14.0)	7.8 (12.0)	5.0 (8.2)	4.2 (7.0)
W. H.	5.0 (9.1)	3.0 (5.8)	4.0 (9.1)	2.8 (5.6)
W. F.	2.0 (2.5)	2.0 (2.0)	2.0 (4.5)	2.8 (8.0)
F. R.	2.8 (3.0)	2.5 (3.2)	2.0 (5.5)	2.5 (5.0)
H. W.	5.6 (7.8)	5.6 (6.0)	4.5 (8.5)	3.1 (7.6)
H. K.	3.8 (6.8)	3.5 (6.5)	4.0 (9.0)	2.2 (4.0)
E. B.	8.8 (14.0)	8.0 (12.0)	8.8 (....)	7.2 (9.0)
Z. Q.	6.8 (....)	6.5 (....)	5.5 (....)	6.0 (11.2)
M. M.	10.5 (....)	11.5 (14.0)	8.0 (7.6)	2.2 (4.0)

permissible to shake the blood after the X-ray exposure, because this will interrupt the already started sedimentation.<sup>4</sup>

We learn from the figures in Table I that the exposure with one skin unit dose has very little effect on the sedimentation velocity, and if there is any, it is not uniform. If two skin unit doses are administered to the test tubes, we find a more-or-less definite retardation which is still more pronounced after the application of a dose of 500 per cent S.U.D.

In our first serial we did accidentally bring the capillaries in an inclined position while exposed to the radiation. We noted after that an enormous acceleration of the sedimentation test which was not due to the exposure of roentgen rays but to this non-vertical position. Linzenmeier and Raunert (5) have reported the same observation and state that the test is three times as fast, if the capillaries are placed at an angle of 45 degrees. We, therefore, in all our following experiments, used a level to make sure of the exact vertical position of our capillaries.

<sup>3</sup> Loc. cit., p. 1081.

<sup>4</sup> See TANAI, K.: *Pflüger's Archiv.*, 1922, Vol. 197, p. 583.

Another precaution must be taken in order to get reliable results. If the blood is not flowing freely out of the wound in the finger-tip and much squeezing has to be done to procure enough blood to fill the pipette, the sedimentation rate will be entirely different. This happens chiefly if two pipettes, one after the other, are filled from one wound in the same finger-tip. We had to repeat a considerable number of tests because discrepancies occurred in the readings of the same person on succeeding days which could not be explained clinically in any way. We, finally, could convince ourselves that this above-mentioned technical error was to blame. We were able to demonstrate this observation by filling from two to four pipettes out of a single wound in the same finger-tip. The differences in the readings were surprising. It seems to us that the amount of fibrin has something to do with this phenomenon.<sup>5</sup>

The figures given in Table I represent the height of the plasma layer after one hour; the total blood column had a certain length, determined by marks on the pipette; in our cases the average height was about sixty millimeters. As it is not possible to prevent a part of the blood from adhering to the capillary wall, the total height of the blood column varies to a certain degree. In order to compare the results directly, we suggest, therefore, the elimination of this slight error creeping in the compilation of the results, by expressing the sedimentation rate as the quotient given by

total height of blood column

which may be called Sedimentation Coefficient. If one also bears in mind that different investigators use a different height of blood column and as the blood column of about 100 millimeters' height is sedimenting nearly two times as fast as the one we used in our experiments, the advantage of choosing this coefficient as an expression of sedimentation velocity is rather evident. The values for normal

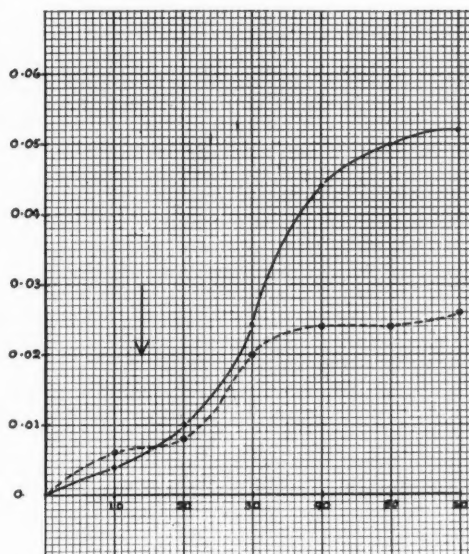


Fig. 2. See explanation below Figure 1.

TABLE II

Person	Control	100 % S.U.D.	200 % S.U.D.	500 % S.U.D.
E. W.	0.14	0.14	0.06	0.04
M. H.	0.09	0.09	0.07	0.06
E. S.	0.06	0.06	0.04	0.05
H. D.	0.14	0.13	0.14	0.1
W. K.	0.08	0.08	0.05	0.06
V. H.	0.08	0.07	0.06	0.04
E. D.	0.14	0.12	0.09	0.06
W. H.	0.09	0.08	0.08	0.05
W. F.	0.03	0.03	0.04	0.02
F. R.	0.04	0.05	0.03	0.04
H. W.	0.1	0.1	0.09	0.06
H. K.	0.06	0.05	0.05	0.2
E. B.	0.15	0.12	0.09	0.1
Z. Q.	0.12	0.12	0.1	0.1
M. M.	0.16	0.17	0.13	0.06

males are between 0.01 and 0.1, the average being 0.04; normal females vary between 0.02 and 0.25, with an average of about 0.14. In Table II the figures of Table I are given again, expressed in this instance in the term of the sedimentation coefficient. If we compare these figures with the results represented in Table I, we notice that several readings have to be interpreted differently; this is due to the correction made by considering the different total height of the blood column in each

<sup>5</sup> R. MOND, *loc. cit.*

single test. A variation in the coefficient of  $\pm 0.02$  is regarded as allowed error.

We, further, tried to find how soon after the exposure to X-rays the effect on the sedimentation velocity manifested itself.

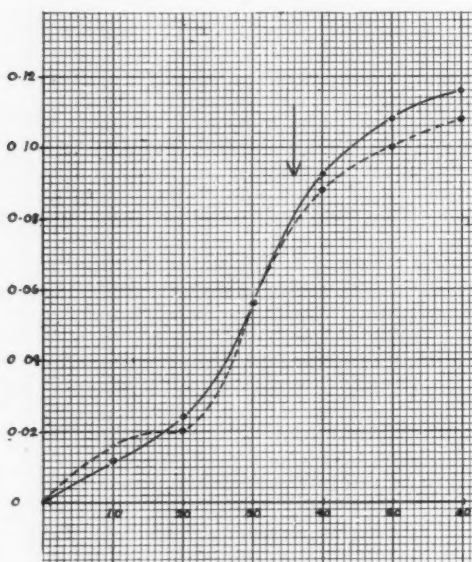


Fig. 3. Same symbols used as in Figure 1.

Curves were plotted comparing the sedimentation rate of the control and the treated tube (Fig. 1). From this curve, as from many similar ones, we deduce that it takes about ten to fifteen minutes after irradiation until the retardation of the sedimentation becomes evident. By varying the time interval between the filling of the test tubes and exposure to radiation, an attempt was made to find the optimum of effect. We give in Figures 2 and 3 examples of our findings; the sooner after the filling of the pipette the roentgen-ray exposure takes place, the more pronounced will be the result. It is understood, of course, that a certain minimum dose of roentgen energy must be applied in order to produce a re-

tardation of the sedimentation velocity high enough to be beyond the allowed error. The fact that an X-ray exposure later than about thirty-five or forty minutes after the sedimentation of the erythrocytes has started in the capillary, does not cause any appreciable change, may be explained by the observations of Rothe (6): in the third stage of the sedimentation process, the so-called stage of sacking, the red blood corpuscles are already packed so tightly together that even if the radiation were effective, this effect could not be traced. The test is not sensitive enough to show such slight differences, as measured by the height of the plasma layer.

#### CONCLUSIONS

(1) Irradiation of the human blood in capillaries with unfiltered roentgen rays influences its suspension-stability. A certain minimum dose is required to cause a definite retardation of the sedimentation velocity.

(2) The sedimentation test is a reversible reaction; it can be reproduced qualitatively, but not quantitatively. Certain precautions have to be observed to get reliable results.

(3) It is suggested that the sedimentation coefficient

$$\frac{\text{height of plasma layer}}{\text{total height of blood column}}$$

be used to express the sedimentation rate. This allows a direct comparison of the results.

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## AN ANALYSIS OF THE END-RESULT: THE RADIOGRAPH

By E. C. JERMAN, CHICAGO

ASSUMING that a clean film, free from fog of any kind, be selected; that proper screens, free from marks, scratches or blemishes, be selected, and that proper dark room procedure, including properly selected chemicals, proper temperatures, proper time factors and safe dark room light, be used, there remain four factors which contribute to the quality of the end-result—the radiograph: First, distortion; second, detail; third, contrast; fourth, radiographic density. A thorough understanding of the various methods that control the above four factors will contribute much toward the control of the quality of the end-result.

*First, Distortion.*—Distortion may be defined, from a radiographic standpoint, as a variation in the size or shape of an object as shown on the film from its true size or shape.

Distortion may consist of, (1) true distortion, in which the shape of the object shown is distorted or twisted from its true shape, or (2) magnified distortion, in which the size of the object shown is magnified or increased in size. A combination of both usually results. True distortion is mainly brought about by an incorrect alignment of the focal spot of the tube, the object to be radiographed, and the film. The minimum of true distortion is obtained by placing the object to be radiographed in a direct line extending from the center of the focal spot of the tube to the center of the film. Magnified distortion is influenced by the distance of the object to be radiographed from the film, and the distance of the focal spot of the tube from the film. Magnified distortion may be reduced to the minimum by placing the object to be radiographed as close to the film as possible and by placing the focal spot of the tube as far away from the film as may

be both practical and convenient. A minimum of distortion is usually most desirable.

Due to the fact that much of the structure to be radiographed cannot be placed in direct contact with the film, and, especially, when it may be desirable to use screens or the Potter-Bucky Diaphragm, and also due to the fact that there is a limit to the distance that the focal spot of the tube may be placed from the film, due to the capacity of both tube and machine, distortion cannot be entirely eliminated. It is common practice to strive for the minimum.

*Second, Detail.*—The words “detail” and “definition” may be considered as synonymous. Detail may be defined, from a radiographic standpoint, as representing the visibility of the contour lines of all objects shown on the film. With good detail all contour lines are clean-cut, sharp and distinct. The lines representing lung structure and the cancellous structure of bone are clean-cut, sharp and distinct. With poor detail, contour lines and lines representing lung structure and the cancellous structure of bone are more or less hazy and indistinct. The same factors that control distortion,—distance of the object to be radiographed from the film, distance of the focal spot of the tube from the film and alignment of the focal spot, object and film,—also affect detail. The closer the object can be placed to the film the better the detail, and *vice versa*. The farther the focal spot can be placed from the film, within certain limits, the better the detail, and *vice versa*. The more nearly the focal spot, the object and the film are placed in a straight line, the better the detail, and *vice versa*. The use—or non-use—of intensifying screens also affects detail. Sharp-



er and better detail is obtained without the use of intensifying screens than can be obtained with them. However, screens are in common use when radiographing the heavier parts, due to the fact that the increased contrast available and the shorter exposure time required outweigh the resulting decrease in the amount of detail. When screens are used the maximum of detail can be obtained only with perfect contact between the film and screens. With poor screen-film contact good detail is impossible. Secondary radiation may also interfere with, or make less plainly visible, good detail. The effect of secondary radiation may be reduced to the minimum by the use of cones or the Potter-Bucky Diaphragm.

One of the most important factors controlling detail is the size of the focal spot of the tube that is used. The smaller the size of the focal spot, all other conditions remaining equal, the sharper and better the detail, and *vice versa*. The broad focus tube and even the medium focus tube are rarely used where sharp detail of lung structure or bone structure is required. The Fine Focus Universal Coolidge tube or the five-thirty Radiator Coolidge tube are ordinarily used where detail is an important factor. Insofar as the tube is concerned, decidedly better detail can be obtained with the five-ten Radiator Coolidge tube. The milliamperage, the time of exposure or the gap or voltage does not affect detail except as it may make detail more or less plainly visible. Dark room procedure does not affect detail except as it may make detail more or less plainly visible. In other words, the manipulation of the milliamperage, time of exposure, gap or voltage, or the dark room procedure is not used for the purpose of controlling detail. The maximum of detail that may be obtained is not always a necessity. In some cases, detail must be sacrificed in order to strengthen other factors. Detail is especially important in the study of bone and lung structure. If the object to be radio-

graphed be placed as close to the film as possible, if the focal spot be placed at a proper distance from the film, if the focal spot, the object and the film be properly aligned, if good screen-film contact be maintained when they are used, if secondary radiation be reduced to the minimum, and if the smallest practicable focal spot be used, the maximum of detail will be obtained either with the use of films alone or with the use of films and screens or with the use of films, screens and the Potter-Bucky Diaphragm. Distortion and detail are closely related, but by a careful study of the radiograph they may be readily differentiated and each brought under control.

*Third, Contrast.*—Contrast may be defined, from a radiographic standpoint, as representing the percentage of difference between the extreme whites and blacks that are shown in a radiograph. The most important factor that may be used for the control of contrast is the time of exposure. The longer the time of exposure (which also means the lower the gap or voltage required to produce the proper density), the greater the contrast, and *vice versa*. In other words, the exposure of an ankle, with a fixed distance and milliamperage, will show more contrast with an exposure of 10 seconds at the required gap or voltage for a 10-second exposure than with an exposure of 1 second at the required gap or voltage for a 1-second exposure. The increase or decrease of the milliamperage factor (with the corresponding decrease or increase of the voltage or gap factor) will also act as a control of contrast. However, the milliamperage factor is not ordinarily used for the control of contrast. It could be so used only within the capacity limits of the tube to be employed. While the distance factor might be used for the control of contrast, it is rarely, if ever, so used. While contrast may be altered by varying certain dark room factors it is not considered good practice to attempt to control contrast by a variation of these factors. A variation of the gap or voltage factor

necessarily follows a variation of the time factor.

The next most important factor for the control of contrast is the use or non-use of intensifying screens. A very marked increase of contrast may be obtained with the use of screens with an exposure time equal to or less than that required when screens are not used. In order to obtain the maximum of contrast, as long an exposure as may seem practicable must be used (with its corresponding reduced voltage or gap), either with films alone, or with films and screens, or with films, screens and the Potter-Bucky Diaphragm. The maximum contrast that can be obtained is rarely, if ever, necessary. The principal effect of increased contrast is to make detail more easily and plainly visible. Increased contrast also adds so-called "snap" and "brilliance" to the radiograph. Such contrast should be produced as will show clearly and well the various areas of different densities, as well as the detail. While snap and brilliance are not always a necessity, they add materially to the clearness and beauty of the radiograph. Contrast may be considerably reduced by secondary radiation. Cones and the Potter-Bucky Diaphragm are used for the purpose of reducing the effect of secondary radiation to the minimum.

*Fourth, Radiographic Density.*—Radiographic density, from a radiographic standpoint, may be defined as representing the general tendency of the radiograph, as a whole, to be lighter or darker in color. A radiograph that is too light or too dark may lose most or all of its diagnostic value. A radiograph may be rather light—under-exposed (lesser density)—or rather dark—over-exposed (greater density)—within certain limits, and still retain all or most of its diagnostic value. A radiograph may be of lesser density or greater density and still retain the same contrast or percentage of difference between the extreme whites and blacks. The radiographic density is ordinarily controlled by a variation of

either the time-of-exposure factor or the gap or voltage factor. The longer the time of exposure or the higher the gap or voltage used, all other factors remaining equal, the greater the density, and *vice versa*. The distance factor or the milliamperage factor are not ordinarily used for the purpose of controlling density. One of the dark room factors, time of development, is also quite frequently used for the purpose of controlling density. If a film has been over-exposed, a shorter time of development may improve the density. The degree of radiographic density that is most desirable is that which will give a maximum of contrast with clearly visible detail. Radiographic density and contrast are closely related, but by a careful study of the radiograph they may be readily differentiated and each brought under control.

#### CONCLUSIONS

If all the factors involved in the making of a selected radiograph are known, it then becomes a simple matter, by means of the above method of analysis, to decide what may be done to improve the quality of that radiograph from the standpoint of distortion, detail, contrast or radiographic density. If the finer or better quality of radiographs are desired, it is very necessary that the operator thoroughly understand, first, the exact meaning of each of the four factors—distortion, detail, contrast and radiographic density, and second, the various methods for the control of each of these factors.

#### FACTORS AFFECTING OR CONTROLLING THE END-RESULT—THE RADIOGRAPH

*Distortion controlled by* (1) distance of object from film; (2) distance of focal spot from film; (3) alignment of focal spot, object and film.

*Detail controlled by* (1) distance of object from film; (2) distance of focal spot from film; (3) alignment of focal spot, object and film; (4) use or non-use of in-

tensifying screens; (5) screen-film contact; screens; (3) secondary radiation; (4) (6) secondary radiation; (7) size of focal (occasionally) milliamperage.  
spot.

*Contrast controlled by* (1) time of exposure; (2) use or non-use of intensifying  
*Radiographic density controlled by* (1) time of exposure; (2) gap or voltage; (3) time of development.

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## CASE REPORTS AND NEW DEVICES

### ANOMALOUS POSITIONS OF APPENDIX AND CECUM

By J. C. KEATON, M.D., ALBANY, GEORGIA

The patient, a well nourished man of forty-seven, was brought by his attending physician. His complaint was a feeling of pressure and fullness in the region of the stomach, accompanied by pain and marked distention of the upper abdominal

meal, shows the cecum to be on the left side, with the ascending colon running parallel to the transverse colon, and the appendix clearly outlined.

### ESOPHAGOBRONCHIAL FISTULA RESULTING FROM ACTINOMYCOSIS: REPORT OF A CASE<sup>1</sup>

By PORTER P. VINSON, M.D., Section on Medicine,  
and CHARLES G. SUTHERLAND, M.B. (Tor.),  
Section on Roentgenology, Mayo Clinic,  
ROCHESTER, MINNESOTA



Fig. 1.

region, and continuous tenderness on the left side. The distress was more marked three to five hours after the taking of food. The case had previously been diagnosed as ulcer of the stomach, and in consequence the man had kept to a strictly enforced diet for the past six or eight years.

The roentgenographic and fluoroscopic findings of the stomach were negative. The accompanying film (Fig. 1), made twenty-four hours after the ingestion of the barium

A woman, aged thirty-seven, was examined at the clinic August 3, 1925. Twenty-eight years previously a swelling had appeared over the right tibia, without ulceration; this persisted for several months but finally disappeared following the local application of iodine. Soon afterward the cervical glands became greatly enlarged, and there was bilateral corneal ulceration. One and one-half years later a swelling appeared over the left tibia, just below the knee; this ulcerated and drained for seven years. When the patient was fourteen, the larynx was ulcerated, and there was aphonia for a year, followed by permanent impairment of phonation. Three years later, she had indefinite upper abdominal distress accompanied by vomiting of large amounts of blood, and she was confined to bed for eighteen weeks. She had difficulty in swallowing, and strangled and coughed on ingesting liquids, which was attributed to the previous laryngeal ulceration. When she was nineteen years of age pain developed in the left side of the chest. One and one-half pints of purulent effusion was aspirated, and two ribs were resected. The wound in the chest healed in six weeks and remained closed for six months. It then reopened and there was constant drainage until September, 1924. Six years before examination a second sinus occurred

<sup>1</sup> Received for publication October 28, 1925.

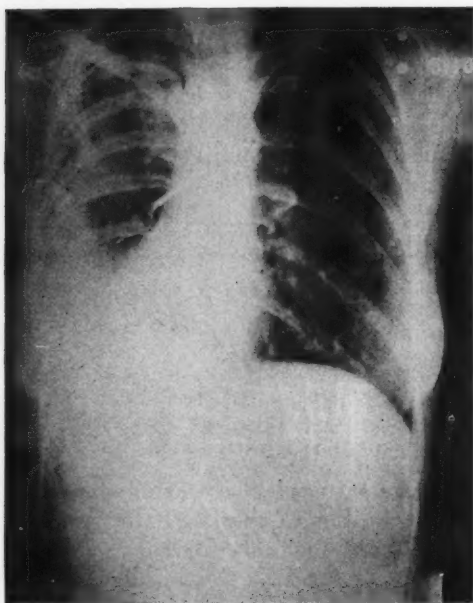


Fig. 1. Marked increased density over the left base and left periphery which was interpreted as an inflammatory lesion. On the left side at the sixth rib level posteriorly, barium is seen entering the bronchus.

on the left side of the chest, just below the first one; this was draining at the time of her examination. For two years preceding her examination the afternoon temperature had ranged from 99° to 99.5°. Repeated examinations of the sputum and sinus discharges were negative for the bacillus of tuberculosis. In January, 1924, these secretions were more carefully examined and were found to contain actinomyces. Potassium iodid was given, 90 grains three times a day, and supplemented by roentgen-ray treatment. During the Spring and Summer of 1924 the patient's general condition improved considerably, but she later became intolerant to the iodids and they had to be discontinued.

General examination revealed a healed scar on the left leg just below the knee. On the left side of the chest in the region of the fourth and fifth ribs in the anterior axillary line there were several draining sinuses and one healed scar. The voice was quite husky and the skin of the entire

chest was tanned by previous exposure to the roentgen ray and sunlight. Smears from the sputum and from the sinuses in the chest revealed actinomyces. The roentgenogram of the chest showed marked increased density over the lower left periphery extending to the second rib, which was interpreted as an inflammatory lesion. The blood Wassermann reaction according to the Kolmer technic was weakly positive, but this was not confirmed by a second examination and it was concluded that the deep-seated actinomycosis was responsible for the serologic findings. Roentgenoscopy revealed an esophagobronchial fistula, but nothing abnormal was found on examining the stomach (Fig. 1). There was marked scarring of the posterior pharyngeal wall, a loss of almost the entire left vocal cord, with scarring extending into the subglottic region. Because of the excellent general condition of the patient and the remarkable acquired resistance to the infection, treatment of any type was not deemed advisable, and she was therefore dismissed from observation.

#### COMMENT

This patient is interesting primarily because of the actinomycosis that had been actively present for twenty-eight years. The wide distribution of the lesions, with the marked resistance, were also interesting features and the development of the esophagobronchial fistula was a most unusual complication.

#### A NEW APPARATUS FOR SERIAL ROENTGENOGRAPHY OF THE GASTRO-INTESTINAL TRACT

The Standard-Engeln Corporation are marketing a comparatively light weight cassette shifting device in combination with a reflected fluoroscopic screen image arrangement for localizing the barium-filled stomach. The stomach and cap can be localized over an aperture in the lead-lined



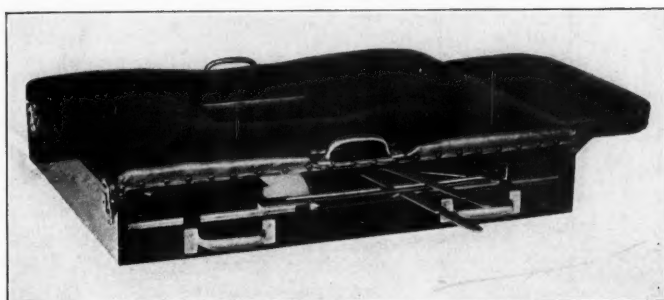


Fig. 1.

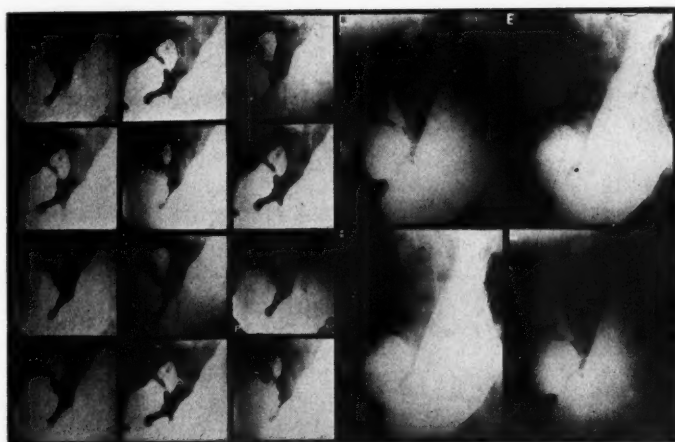


Fig. 3.

top, which is selective as to size. The operator is enabled to project either four views  $7\frac{1}{2} \times 8$  inches in area, or twelve views  $4\frac{1}{4} \times 4\frac{1}{2}$  inches. The control of the shifting arrangement is simple and there are no long projecting levers or handles. All controls have name and number plates indicating the selection (Fig. 1).

The view projections can be made as rapidly as desired, a second only being required to make the shift.

A mirror set at an angle and viewed from the operating side permits a view of the stomach, or any part of the stomach or duodenum which it is desired to project upon the film. This mirror is set within the cabinet and reflects a fluoroscopic

screen which is mounted on the bottom of the upper section.

It has been made in two sections, for ease in transportation—either to remove it from the table or to place it in the erect position (Fig. 2). The cover with its lead protection and upholstered top is secured to the lower section by clasps. Both sections have conveniently placed handles, and have been constructed as light as possible.

With the Serialograph it is possible to obtain a large number of views of the stomach and duodenum in a given position without disturbing the position of the patient. For instance, twelve views of the pyloric end of the stomach and the first and second portions of the duodenum are

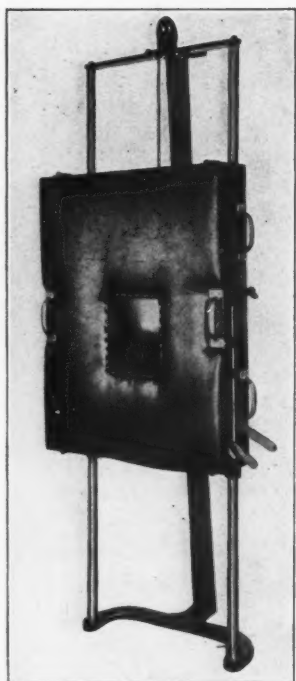


Fig. 2.

obtained at varying periods of the peristaltic cycle without moving the patient (Fig. 3). With the aid of the fluoroscopic image for localization, the operator is assured of proper projection. Either twelve or four exposures, according to the area selected, may be made on a  $14 \times 17$  film.

### BRAIN TUMOR: RESPONSE TO RADIATION<sup>1</sup>

By JOHN S. DERR, M.D., ATLANTA, GA.

I wish to report briefly a case of brain tumor, glioma, operated on by Dr. Charles E. Dowman, and referred to me for post-operative X-ray treatment Dec. 12, 1921.

**Family history:** Negative, white, female, age 16.

**Present illness:** Staggering gait first noticed two years previous to examination, growing progressively worse; headache—occipital in location, principally on right

side—noticed by patient about same time. These headaches have occurred every day—worse in the morning. Weakness in limbs and pains in knees. Patient has had tonsillectomy, removal of adenoids and two abscessed teeth.

**Vomiting:** First began in August, 1921; projectile in character; last attack occurred three days before examination.

**Vision:** Began to fail in 1921, growing progressively worse; diplopia is also present.

**Examination:** Patient is well nourished; head well shaped; no particular area of tenderness. X-ray examination shows convolution atrophy changes in the skull, especially over cerebrum. Posterior clinoid processes are thinned out and shoved downward. Such changes are not infrequently found in cases of chronic increased pressure, especially in tumors of the posterior fossa.

**Operation,** Nov. 14, 1921, revealed a tumor of the left cerebellar lobe containing about 30 c.c. of fluid.

**Diagnosis:** Gliomatous cyst; only a cerebellar decompression was done.

Referred for X-ray treatment, Dec. 12, 1921. At the time of the first treatment, patient could walk only by being supported, owing to lack of co-ordination. There was some bulging of the left cerebellar region, and the wound was still covered by a dressing. X-ray treatment was given over the occiput with a 5-inch cone, target distance 9 inches, filtration, 9 mm. of aluminum, sole leather and flannel pad, with approximately 5 milliamperes and 10-inch gap (150 K.V.).

**January 12, 1922:** Patient has much improved since last treatment. No headaches until on a recent day, and she walks much better. No skin reaction. Two areas cross-fired on back of head. Same technic. Time, 15 minutes on each side.

**February 23, 1922:** Two areas on each side of occiput. Same technic. Time, 15 minutes on each side. Patient doing well.

<sup>1</sup> Received for publication October 15, 1925.

No headaches, walking better, no skin reaction visible. Hair on back of head falling out.

*April 20, 1922:* Patient now weighs 121 pounds and has no more headaches. Her menses appeared two months ago and are regular. Her general health is good and her walk is almost without stagger. No treatment.

*July 20, 1922:* Patient's general condition shows marked improvement. Hair is coming out over occiput, which shows very much less bulging. Result is excellent. No change in technic is advisable. Two areas, one on each side of occiput, directed inward. Time, 15 minutes.

*December 1, 1922:* Patient had very little nausea after last treatment. Except for an attack of malaria, which has pulled her down, her condition has been entirely satisfactory. The hair on the back of her head has returned, short and gray. Further treatment has been advised. Two areas, one on each side of occiput; same technic. Time, 15 minutes on each side. Total amount of time on left side of occiput, 1 hour 15 minutes; total amount of time on right side of occiput, 1 hour 15 minutes. Patient has improved steadily in every respect, her eye symptoms have cleared up, and her gait has become normal.

Patient returned for examination in October, 1923. At this time Dr. Dowman thought he could detect, by deep pressure, a tumor mass over the occiput at the right decompression. The second operation was done Oct. 24, with the following findings: Regenerated bone filled decompression window, giving sense of tumor mass. The tumor in the left cerebellar lobe was found to be reduced to a mass of yellowish granular material which Dr. Dowman concluded was the remains of the destroyed glioma. No attempt to remove this was made and the wound was closed.

Patient is still doing well and has had no return of her old trouble.

## EARLY DIAGNOSIS AND LOCALIZATION OF BRAIN TUMORS

By E. R. CARPENTER, M.D., DALLAS, TEXAS

SINCE the introduction of roentgen-ray facilities in diagnosis, brain tumor work has assumed an important place in medicine and surgery. These tumors occur quite frequently and in former years they caused much confusion in intracranial work, and even now the subject is poorly understood by the profession as a whole and recent advancements are not fully appreciated by many physicians and surgeons especially interested in this subject.



Fig. 1. Normal ventricles in a patient previously considered to be a "brain tumor suspect."

From properly made roentgen-ray films much evidence of brain tumors can be discerned by experts in the work, but as a rule the tumors are well developed or even in the terminal stage when seen by the brain specialists. In 80 per cent of all brain tumors the "full blown" and terminal stages are preceded by headaches for something like two and one-half years on an average and diagnosis should be made during this period. With the aid of pneumoventriculography all brain tumor suspects can be studied and a diagnosis can

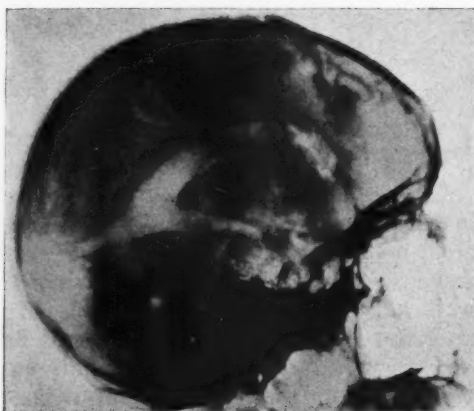


Fig. 2. Normal lateral ventricle in a patient who had convulsions from an unknown origin.

be made, if a tumor is present, in at least 90 per cent of these patients long before gross changes in the eye ground and focal symptoms occur.

The ventricular air test is not dangerous in the early stages of brain tumors when it is properly made and interpreted in connection with the headaches, as discussed



Fig. 3. Case 1. Slight enlargement of the lateral ventricles in an early stage of a cerebellar tumor without eye changes or focal symptoms being present.

by the writer in a monograph on Chronic Headaches now being prepared for publication. In the fully developed and terminal stages of brain tumors the test is somewhat dangerous in certain cases.

#### CASE REPORTS

*Case 1.* G. E. B., aged twenty-three, had had headaches for one year at the time of examination. His eye grounds were normal and no focal symptoms were present. Diagnosis and localization were made by means of the ventricular air test and the Bárány vestibular test.

This man was examined January 27, 1925. For one year he had had more headaches than usual and for three months he had been unable to work at times on account of the pain in the back of his head. He had vomited two or three times. His vision was 20-20 in each eye. The fields of vision were normal and there were no gross changes in the eye grounds. His hearing was normal. All the cranial nerves reacted normally with the exception of the absence of past-pointing with the right hand to the left when the left ear was irrigated with cold water. The motor system was normal. There was slight ataxia and a



Fig. 4. Lateral view of the right ventricle. No clinical symptoms present except headaches.

small amount of dysmetria of the right hand. All laboratory tests were negative.

The usual roentgen-ray films of the head were negative. The ventricular air test revealed moderately enlarged lateral ventricles (Fig. 3). From this it was obvious

seven years. There was slight evidence of a tumor in the left parietal bone near the midline, which was verified by the ventricular air test.

This patient had developed headaches seven years before, which became more

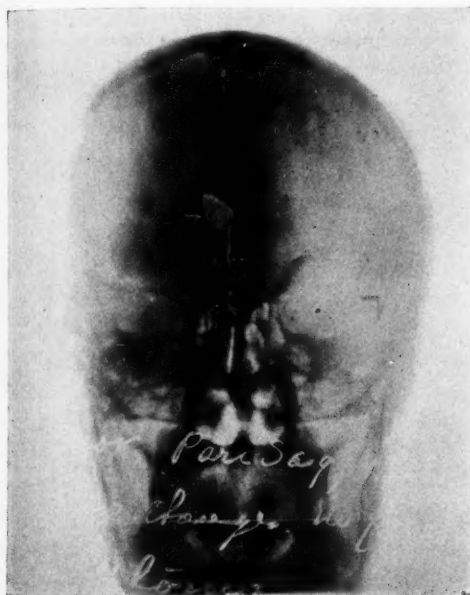


Fig. 5. Case 2. Retouched areas of the right lateral and third ventricles as revealed by the ventriculograms of a patient with a brain tumor in the left parietal region. Eye grounds were normal and no focal symptoms were present.

there was obstruction in the brain stem or in the third ventricle. The absence of cranial nerve involvement, the presence of slight ataxia and dysmetria of the right hand, along with the absence of past-pointing of the right hand to the left in the Bárány test, indicated that he had a lesion in the upper part of the right cerebellar lobe. Three days later he suddenly developed marked inco-ordination of the right hand. Operation revealed a recent hemorrhage from a small glioma situated in the upper part of the right cerebellar lobe as predicted before the hemorrhage occurred.

**Case 2.** Mrs. C. H. C., aged thirty-four, had had severe recurring headaches for

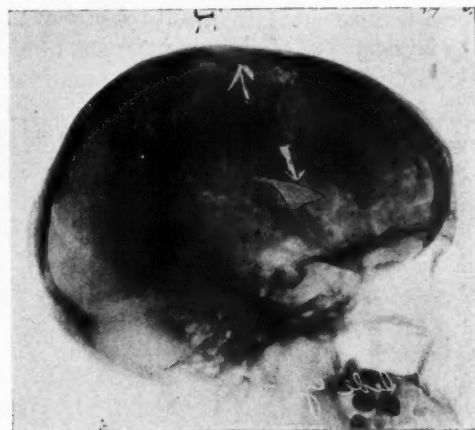


Fig. 6. Case 2. Retouched area of right ventricle. Upper arrow indicates slight density on the left side. Headaches for seven years.

severe in time. Opiates were necessary at intervals. Many examinations had been made. She had been told the headaches were of a psychic nature. She had undergone an operation for gall-bladder disease. Her vision was 20/20 in each eye. The fields of vision and fundi were normal. There was no evidence of organic lesion of the brain. Two years before, the writer had advised her to have the ventricular air test made for brain tumor, but this was refused until about four months before the time of writing, when the test revealed obliteration of the left lateral ventricle and absence of the upper half of the right lateral ventricular space, while the third and fourth ventricles were unobstructed (Figs. 5 and 6).

From the history, and the slight density on the left side of the head and from the ventriculograms, a diagnosis of para-sagittal meningioma approaching the "full blown" stage was justified. Operation has been refused, and the patient probably will



wait until late symptoms develop before she seeks the relief that could have been obtained several years ago under more favorable conditions.

COMMENT

Similar conditions to those reported in these two cases are frequently met with in the investigation of chronic recurring head-

aches from various causes. When chronic headaches become better understood and when the value of the ventricular air test in brain lesions receives proper appreciation, "brain tumor suspects" will not be advised to wait for months or years until late symptoms develop in order to have a diagnosis made and to undergo appropriate treatment.

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# EDITORIAL

M. J. HUBENY, M.D. . . . . Editor  
BENJAMIN H. ORNDOFF, M.D. } . Associate Editors  
JOHN D. CAMP, M.D.

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## THE ROUTINE USE OF HIGH VOLTAGE

Advocates of fixed systems of irradiation technic have been so strong in their claims, and the advantages of "deep therapy" so widely heralded, that in some places 200 kilovolts is used as a routine treatment for all cancers. Yet extensive investigations have not confirmed much of the physical, clinical, or biologic data on which deep therapy is supposedly based. In spite of enthusiastic claims of the superiority of homogeneous radiation, clinical results have not justified its universal use; in fact, in many places the enthusiasm for high voltage is waning, and in practically all clinics roentgenotherapy is advancing away from its status as a physical concept toward that of a bioclinical.

The theory that tumors react uniformly to uniform doses of rays is largely abandoned as untenable in the light of clinical experience. Not infrequently the "cancer dose" delivered to a tumor causes damage which necessitates cautious downward grading of intensity; some physicians even irradiate with one-tenth of the usual dose to each field daily to minimize upsets.

Tissue reactions are being watched, and the biochemical effects of rays of short wave length investigated. Time and space relations of clinical dosimetry are being studied, but as yet the data are not sufficient

for conclusions to be drawn. Physical concepts applicable to cancer of the cervix are not necessarily applicable to cancer elsewhere, because of difference in situation of the tumor and varying unknown factors that constitute malignancy. Since the biology of cancer is imperfectly understood the treatment of a given cancer in a given patient depends rather on clinical experience than on mathematical physics.

That absorbed rays alone produce regression of a tumor seems an established fact, but we do not know at present what kind of rays are most thoroughly absorbed by the tumor. The study of filters and voltages leaves an enormous field for biologic investigation, and many of the reported experiments need elaboration. Likewise, many of the reports of curative or palliative results need confirmation. We do know that high voltage will produce results unattainable otherwise; we do know it has a fixed place in the treatment of certain tumors, but to what extent it can replace or augment other therapeutic agents clinical experience in the future alone can determine.

If, then, the radiologic attack on cancer is to progress at all satisfactorily, the therapist must be familiar with the disease and the physical and biologic interreactions of the roentgen ray in the body, instead of relying wholly on empiric methods. The disease and its irradiation should be individualized from many different angles; otherwise, roentgenotherapy will be empirical, premature generalizations will be drawn, and the high voltage roentgen ray, instead of holding a place in treatment, will tend to be abandoned.

EUGENE T. LEDDY, M.D.

RESOLUTIONS ADOPTED AT ELEVENTH ANNUAL MEETING,  
DECEMBER, 1925

MR. PRESIDENT: Before adjournment it seems proper to give expression to the sentiments of the membership of the Radiological Society of North America.

The officers of the Society are to be congratulated upon the success of their efforts. The meeting and business of the Society have been conducted in an orderly and efficient manner, giving universal satisfaction to the membership.

The Program Committee has set a high mark in the program brought to the meeting. Men of the highest standing in the profession, from the farthest parts of the United States and Canada as well as from beyond the seas, have presented to us the best that radiology and kindred sciences have to offer. Our sincerest thanks are due to Dr. Forestier and those eminent men who are not members of our Society for their valued contributions. This meeting has demonstrated that radiology has earned and deserves standing among the most useful and promising specialties in medicine.

The Local Committee of Arrangements deserves our sincerest thanks for the pleasant and comfortable arrangements for our housing and meetings, as well as for the efficient and agreeable assistance of the ladies who assisted at the registration desk.

Especially should be mentioned the Ladies' Committee, for the delightful entertainment of the visiting ladies. By their thoughtfulness, kindness, and courtesy, as well as by the character of the entertainment, they have made personal friends of the visiting ladies and the membership of the Society.

No meeting would be complete without the exhibitors. They make it possible for us to inspect each year the newest and most advanced equipment of our profession. We hope those who so favored us may profit by their visit to our meeting.

In view of the above facts,

*Be it resolved:* That the sincerest thanks of the Radiological Society of North America be extended to those mentioned, as well as to the citizens of Cleveland and all those who have contributed to the success of this meeting.

Signed:

JOHN F. HERRICK,  
FRANK W. MACKOY,  
SHERWOOD MOORE,  
*Committee.*

THE COMMERCIAL EXHIBIT

Among the exhibitors at the Eleventh Annual Meeting of the Radiological Society of North America who greeted their old friends and made new ones were the following:

George W. Brady & Co. showed both the 17 x 17 and the 11 x 14 size flat Potter-Bucky Diaphragms, in addition to their curved top style. They have an attachment for holding the patient's head steady while radiographing, including a head clamp with balls to fit the ears for squaring up the head, and the attachments for making exposures automatically. A new treatment timer clock for intervals up to ninety minutes, and the Granger mastoid localizer and sphenoid masks were among the accessories shown. Tetraiodide tablets for visualization of the gall bladder, also coated capsules for oral administration and in form for intravenous use were also shown, together with a complete working technic for both methods. A diathermic electrode for ear treatment and a film perforator were also on exhibition by Mr. Brady, who personally greeted his friends.

The Radium Emanation Corporation, of New York, showed beta ray applicators for implantation of seeds and a new style of applicator similar to the seed applicator, for the implantation of platinum seeds. On exhibition also were Dr. Régaud's rubber applicators for the treatment of carcinoma of the cervix. The literature available on this technic was to be had at this

exhibit, which was in charge of Mr. McAleese.

The Patterson Screen Company, of Towanda, Pa., besides showing the Patterson Cleanable Intensifying Screen and the Fluoroscopic Screen, demonstrated the Foreign Body Fluoroscope, an apparatus developed by Dr. Robert A. Arens, of Chicago.

Visitors manifested interest in two developments in X-ray apparatus shown by the Wappler Electric Company, of Long Island City, N. Y., namely, the "Monex," an X-ray transformer of high capacity for diagnostic work in which the usual motor and rotating rectifier are dispensed with. The uni-directional high tension current to be delivered to the X-ray tube is obtained by means of a "Kenex," or hot cathode valve tube connecting between two sections of the high tension windings. It is claimed that, in addition to the advantage of silent operation, greater radiographic value is obtained than with the mechanical rectifier, due to the flattening of the wave and the sustaining of its high voltage value. The other apparatus featured by this company was a new upright cassette changer, operating with smoothness and precision. Gravity is used both as a motive power and as a retarding force. The details of convenience in the handling of cassettes of all sizes and the placing of the carriage in relation to the patient have been worked out.

The Buck X-graph Company, of St. Louis, showed an interesting line of intensifying screens, cassettes, dental films, etc. In addition, the new film dryer attracted the attention of the visiting radiologists. This exhibit was in charge of Mr. Buck, who has a host of friends among radiologists.

The Hanovia Chemical & Manufacturing Co., of Newark, N. J., makers of mercury vapor quartz lamps, showed the Portable Unit Self-suspending Kromayer Lamp and the Floor Type Sollux Lamp. The makers claim for the former that it offers a solution for the operation of water-cooled lamps, since it does not depend on an out-

side water supply. The weight of the lamp is counterbalanced, with the idea that in making applications with it the operator is relieved of maintaining a fatiguing position. H. M. Shaw, F. W. Robinson and W. R. Hosmer greeted their friends and explained the lamps.

The Kelley-Koett Manufacturing Co., Covington, Ky., showed a new table for making all pictures of the head. The tube can be tilted to any angle for any degree work, the central ray always being focused on the center of the film. A flat Bucky is included. This company showed also a pendulum type plate changer with automatic weight shift, arranged to hold cassettes either in the vertical or horizontal position. There was an all-metal stereoscope, with improved stereoscopic boxes, using a double glass window, the film being placed between the glasses so as to avoid its curling or wrinkling. There was a motor-driven table for fluoroscopy, which could be tilted to the Trendelenburg position or forward to the vertical position. They showed a new model Type 7 machine with double disc rectification, using a minimum of parts and having a guarantee of 200 milliamperes at a 6-inch back-up; also a 230,000-volt, 50-milliamperes therapy machine, using double disc rectification. There was also shown by this company the Power Plus double disc unit with a record of 525 milliamperes at 120,000 peak kilovolts.

The Acme-International X-ray Company exhibited in their booth, their latest production being their combination Bucky fluoroscopic and radiographic table. The Acme six-sixty unit, "The little machine with a powerful punch," was also on display. The demand for diathermic work, being said to be on the increase, the Acme Company do not believe that their exhibit is complete at any meeting unless they have on display their Polytherm machine. A large corps of men from the Acme-International organization from all parts of the

country were daily at the booth to explain their exhibit and greet their friends.

The Liebel-Flarsheim Co., of Cincinnati, exhibited the Model P Dynelectron diathermy and electrocoagulation apparatus, already familiar to many roentgenologists. In addition, an electric scalpel (radio knife) recently put on the market by this company created considerable interest. This apparatus works on the spark gap principle and eliminates the radio transmitting bulbs previously used on equipment of this character and possesses the advantage that it is now possible definitely to control the depth of dehydration of the severed tissues.

James Picker, Inc., showed Kerasol, a specially coated capsule of sodium tetraiodophenolphthalein, for oral administration of gall-bladder dye.

The Standard Engeln Company exhibited their combination De Luxe deep therapy and radiographic machine, designed to deliver 260 peak kilovolts. An 8-inch combination machine, capable of delivering current and voltage sufficient to operate any radiographic tube on the market was also shown. The patented safety winding is embodied in both of these transformers. A new vertical fluoroscope, for which maximum screen travel, compactness and lightness are claimed, was shown. The Standard direct-contact-reading Roentgenometer was shown for the first time.

The Reaves Instrument Shop, of Greensboro, N. C., showed the Radiograph-scope, designed for the use of the radiologist in demonstrating his findings to the consultant. The Universal Marker was also on exhibition, and its use explained.

The Price Manufacturing Co., of Cleveland, Ohio, showed their line of X-ray protection supplies consisting of gloves, aprons, sheets, and face protectors.

The French Screen Company exhibited their Intensifying Screen, sold under a three-year guarantee for efficiency, and upon which a yearly service is rendered. The French Fluoroscopic Screen, designed

to give a sharp black-and-white image and permitting of longer examinations, was shown.

The Eastman Kodak Company, Rochester, N. Y., was represented by Mr. F. C. Martin, Dr. Otto Dohn, Mr. J. E. McGhee, Mr. R. T. Morrison, and Mr. C. J. Eacock, who showed the firm's duplitizing film and the Ciné Kodak, as well as photographs made with the clinical camera outfit.

The Lafayette Pharmacal Company, of Lafayette, Ind., showed Enterocap substances and the Mallinckrodt Chemical Works gall-bladder dyes, adjacent to the exhibition of the products of Cooper & Cooper, the Eastern representatives.

The conspicuous feature of the Victor Company's exhibition was the new equipment shown, namely, a new vertical tube shifter of unusual type in that it is an integral part of the stand and is operated without the use of dash pots, air chambers or other devices of this character for absorbing the momentum of the shift. They showed a new time switch for all classes of radiographic work but designed particularly for 1/20th second work, with unusual safeguards for maintaining extreme accuracy. Another feature was a motor-driven combination table with provision for automatic stops in the vertical, horizontal and Trendelenburg positions. The motor-drive feature is added to the table without sacrifice of its other advantageous features as an X-ray table, it is claimed. A fluoroscopic grid was shown, designed for use with the vertical fluoroscope, in which means has been provided for rotating the grid to assist in the visual examination, when it is desirable to have the lines of the grid in another position in reference to the part being examined.

The Horlick's Malted Milk Co., of Racine, Wis., had an exhibit over which Mr. H. L. Conn presided, and which he explained, pointing out the variations in temperature, flavor, and consistency possible in the preparation of the barium meal.



## THE WRECKER

*That ruins men's careers;  
That destroys their happiness;  
That works silently and unnoticed;  
That is deadlier than the machine gun;  
That wrecks homes and scatters families;  
That wastes money saved for a "rainy day";  
That is as great an enemy of mankind as disease;  
That finds its victims among all classes of people—  
IS CARELESSNESS.*

—Anonymous.

## ABSTRACTS OF CURRENT LITERATURE

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**Physiologic methods.**—In this brief summary, only a few of the most important considerations could be presented. The recommendations indicated can be summed up finally in a plea which has been made many times before, and by much abler supplicants than himself, the writer states. It should have produced its effect wherever medicine and surgery are practised. Unfortunately, except in a comparatively few large clinics, it has fallen on unresponsive ears.

Impaired physiologic functions of patients demand as much consideration and treatment as their organic diseases. This can be accomplished by developing a physiologic point of view, and using physiologic methods of study and treatment. Finally, this will be possible only by the

expenditure of intelligent energy, and when surgeons are sufficiently farsighted to secure at all times the close co-operation with them of internists, laboratory workers, interns and nurses.

W. W. WASSON, M.D.

*Poor Surgical Risks: Laboratory Assistance in Preparation of Patients for Operation and in Their Post-operative Care. William Thalheimer. Jour. Am. Med. Assn., Sept. 12, 1925, p. 806.*

**Radiation of spinal cord tumors.**—Eighty-one cases of spinal cord tumors operated on and traced, show those receiving radiation therapy to have survived no longer than those not receiving radiation. One case, metastatic spongioblastoma over the cauda equina, secondary to a growth in posterior cranial fossa previously removed, showed no relief of symptoms following laminectomy and radiation. The patient later died from recurrence of tumor in cerebellum and postmortem showed no remnant of tumor in cord remaining.

S. C. BARROW, M.D.

*Some Aspects of the Diagnosis and Surgical Treatment of Tumors of the Spinal Cord. Charles A. Elsberg. Annals of Surgery, June, 1925, p. 1057.*

**Fragment mitoses in irradiated basal cell carcinoma.**—Alberti and Politzer have observed in the cornea of salamander embryos the time and quantitative factor of the disturbance in mitosis after radiation. They found a marked reduction of mitoses, which came practically to a standstill immediately after the exposure (primary effect), followed by an increase (secondary effect) of the so-called fragment mitosis. Repeated radiation during the time of this secondary effect resulted in an increase of the reaction, much higher than corresponding to the sum of the doses given. In other words, this observation might enable us to find a time for the second treatment of a malignancy when the optimum of effect would result.

Schwarz has repeated these experiments with an ulcerated basal carcinoma on the left cheek of an 80-year-old woman. Biopsies were done before and every twenty-four hours after the treatment until the tenth day. Three fractional doses of 8 H each through 0.5 Zn. plus 1.0 Al. on three successive days were given. Sixteen days after the first treatment the tumor had reduced to half size. Two  $\times$  5 H were given again. Two months later the lesion was completely healed. Beginning on the tenth day a peculiar elevation had formed on the edge of the ulcer which histologically was similar to a cancrroid. This must have been, however, only

a reparative process, because the lesion healed completely with a smooth, whitish scar. The author could not find the same changes as Alberti and Politzer have reported; for several days after the exposure the number of mitoses remained about the same, then increasing and showing fragment mitoses, finally decreasing and showing cell necrosis. Schwarz concluded that there is consequently no danger in giving fractional doses over two or three days. He also states that continuous biopsies are harmless and do not stimulate the tumor growth, at least not in cases under radiation and on the way to healing. (The abstractor would like to refer here to the observation of Heymann, Stockholm, who demonstrated very convincingly that in his cases of cervical carcinoma where the same procedure was followed, namely, taking tumor tissue for microscopic examination several times during the treatment period, the results were discouraging; as soon as he discontinued the biopsies after the beginning of the treatment, this changed entirely. It seems, therefore, advisable not to generalize the observation of Schwarz, so much the more as there is no agreement reached on the question of doing a biopsy at all before radiation therapy.)

E. A. POHLE, M.D.

*The Biology of Irradiated Tumors. G. Schwarz. Strahlentherapie, 1925, Vol. 20, 1, p. 67.*

**Radiographs of the head in childhood.**—During the last three years all of the children referred to the neurological department of the Children's Hospital in Los Angeles have had the head radiographed. A comparison between the X-ray findings and the clinical findings has been undertaken in the hope that it might lead to something of value, either in diagnosis or treatment. This paper is a discussion and analysis of the findings, and is to be considered as a preliminary report.

The early radiographs of the skull were directed to a study of the sella turcica. All patients were under 14 years of age and many under 5. In all, 207 heads were roentgenographed. One hundred and one, or, roughly, one-half, of these the author felt should be classified as normal skulls, from the radiological standpoint. Nine anomalies were found, 5 of which were actual defects. Four cases showed extra sutures in the frontal and parietal bones. Ten cases of variation of size and shape, produced by disturbance in growth, were found, this disturbance, in turn, being due to anomalies of the contents of the skull. Three of these were microcephalies and 7 megalcephalies, the latter with one exception being associated with hydro-

cephalus; two of the three former were associated with impairment of mentality.

The author groups the premature synostosis of the skull under three headings: the dolichocephaly (long head); brachycephaly (short head), and turriccephaly (turret head). In the series were found one brachycephaly and two turriccephalies. One of these patients was a definite mental defective with possible mild hypo-pituitary syndrome. Another was a quite marked case of rickets, while the third showed a defect in the occipital region, with a meningocele, a habit spasm, and two cervical ribs: this child was normal mentally. None of these cases proved to be luetic. Deformities of the skull in systemic diseases do not appear to be easily recognizable from the X-ray films alone, the method pursued in the present study.

Five cases of tumor, all of the soft tissues, were found. There were in the series eight cases of injury to the skull. Sellaes were classified as large, small, and closed in. Of the large, there were eight: two of these were classified as idiopathic epilepsy; three, as brain tumor; one, as multiple exostoses; one, as epilepsy due to birth injury, and one, as hydrocephalus. No signs of erosion were found in these cases. There were six in the small sella group. One of these was studied because of an accident; one had a sixth nerve paralysis, cause unknown; the other four were deficient mentally. There were ten of the so-called "closed in" group. Six of these showed definite clinical evidence of intracranial pressure; four showed signs of focal irritation; only one, an imbecile, showed signs of deficient pituitary secretion. From the clinical standpoint the large, small, or "closed in" sella cannot represent any definite pituitary syndrome. Of the 207 heads studied, only twenty-four, or 11 per cent, showed sufficient variation of the sella to be considered remarkable. Of these twenty-four, 2, or 8 per cent, showed clinical evidence of pituitary disorder.

It is suggested to the author's mind that con-volational markings, so-called, cannot be explained solely on the theory of increased long continued pressure. General nutritional changes seem to be a possible etiological factor which it is hoped to investigate more fully in a further study.

F. B. SHELDON, M.D.

*Radiographs of the Head in Childhood, from a Clinical Standpoint. H. Douglas Eaton. Calif. and Western Med., July, 1925, p. 862.*

**Edema.**—Congenital lymphangiectatic edema, as in the case reported, has resisted all forms of treatment tried, and has shown no tendency toward improvement. A definite etiology has

not been established, but the evidence presumes a congenital defect in the lymphatic system. This is a rare form of edema, and it is to be differentiated from cases listed under the term congenital elephantiasis.

W. W. WASSON, M.D.

*Congenital Lymphangiectatic Edema. Harold O. Ruh and Leon H. Dembo. Jour. Am. Med. Assn., May 9, 1925, p. 1410.*

**The "ultra sun lamp" for heliotherapy.**—This carbon arc light, constructed by Laudeker-Steinberg, emits a spectrum similar to that of the sun. Practically all burning ultra-violet rays, i.e., rays below 2,900 A.U., are missing in this light and it is, therefore, very useful for the exposure of the mucous membranes. Exposures from ten to thirty minutes can be done without causing any reaction.

The author reports the experience of his clinic in gynecological cases (parametritis, pyosalpinx, colpitis, slow healing wounds). The general influence on blood pressure, leukocytes and blood sugar is the same as given by other investigators who worked with a different type of lamp. It is stated that although this light has no specific effect, it may be recommended on account of its properties.

E. A. POHLE, M.D.

*Our Experience with the Non-burning Ultra Sun Lamp. F. Netzer. Strahlentherapie, 1925, Vol. 20, 1, p. 181.*

**Non-opaque foreign bodies in trachea.**—Confidence in the roentgen ray as a diagnostic positivity in foreign bodies in the trachea or bronchi increases daily. From a pathological point of view the non-opaque foreign body causes one or more of four changes to occur in the lung, distal to the foreign body when it is lodged in the bronchi of the same: (1) Obstructive emphysema; (2) atelectasis; (3) drowned lung; (4) abscess.

The roentgen-ray signs of obstruction in one lung as a result of a bronchial foreign body are: (1) increased transparency of the affected lung; (2) depression and partial fixation on the affected side; (3) displacement of the heart and mediastinal structures from the affected side; (4) increased excursion of the diaphragm on the unaffected side due to a compensatory emphysema.

It is most important to remember that all of the symptoms and signs are determined by comparing the view of inspiration with that of expiration and that the first three of the results of bronchial foreign body which have been listed in the previous paragraphs are the most

noticeable at the end of expiration. When the foreign body is in the trachea there is increased aëration of both lungs. Both diaphragms are depressed, the heart rotates, and the transverse diameter of the chest is shorter on expiration than on inspiration.

The most common opaque transverse foreign body is the watermelon seed, the next, a grain of corn. Peanut kernels are also commonly found. All of the above have been known to produce obstruction emphysema of both lungs when lodged in the trachea.

The technic of the roentgen examination is as follows: Be sure that the child is lying flat on the back, chin in line with the sternum, arms above the head. When a foreign body is in the trachea diaphragmatic motion will be either limited or paroxysmal. The exposure must be made so rapidly that even breathing will not blur the film. Intensifying screen must be used to get the time of one-thirtieth and one-fiftieth of a second. The tube is placed at 36-inch distance. Exposures are always made anteroposteriorly, always through the medial line, at exactly the same distance and as nearly as possible the same film-tube-and-patient relationship should exist for each exposure.

B. C. CUSHWAY, M.D.

*Roentgen Diagnosis of Non-opaque Foreign Bodies in the Trachea. Willis F. Manges. Am. Jour. Roentgenol. and Rad. Ther., May, 1925, p. 429.*

**Neurology.**—Among the diagnostic methods used in neurology, the procedure advocated by Sicard of injecting lipiodol (54 per cent solution of metallic iodine in poppy oil), in the diagnosis of cord tumors, is a very interesting advance in neurologic diagnosis. The preferable route of injection is into the cisterna. No spinal fluid is removed for a week preceding the injection. The deep tissues leading to the ligament are anesthetized with novocain; after being sure that the needle is in the cisterna, 1½ c.c. of lipiodol is injected, making sure that the lipiodol is transparent and not brown and that no air is injected. No spinal fluid is removed. Immediately after injection patient is seated and the vertebral segments just below the injection are percussed vigorously with the finger to help the downward passage of the lipiodol. Patient should be kept seated for three or four hours. Radiographs are made from one to four hours after injection, with patient horizontal during the exposures. They should be taken at intervals during the next two or three days to note changes in the lipiodol image. Arrest of the lipiodol indicates obstruc-



tion in the canal; generally the arrest will be total and abrupt.

Ayer and Mixer have used the method on animals and advise caution in its use, saying that it should be reserved for cases where other clinical and laboratory methods are insufficient.

W. W. WATKINS, M.D.

*Progress in Neurology. Abraham Myerson. Boston Med. and Surg. Jour., June 11, 1925, p. 1165.*

**Gastric and intestinal secretions.**—The problem of an indirect influence of X-ray radiation on the secretions of the stomach and duodenum was investigated. Dogs were treated over the upper and lower parts of the body, while carefully protecting the stomach and intestines. The examination of the secretions taken from a gastric and duodenal fistula after small and large doses did not show any appreciable disturbance of the normal composition of these fluids.

E. A. POHLE, M.D.

*Gastric and Intestinal Secretions after X-ray Exposure. W. Dieterich and F. Rost. Strahlentherapie, 1925, Vol. 20, 1, p. 108.*

**Technic for asthma and bronchitis.**—The author reviews the literature regarding the subject from the earliest reports of fifteen years ago and describes the two accepted methods of treatment: the direct, in which the thorax alone is treated, and the indirect, in which treatment is confined to the spleen. He describes the possible mechanisms of relief: first, effects on the lymph nodes; second, effects on the bronchial epithelium, from the direct method and the possible initiation of an immunizing reaction through the indirect method.

In his own work, he has combined the two methods, giving exposures to the anterior and posterior aspects of the chest and to the spleen on successive days or alternate days. The voltage has been 170 K.V. or 200 K.V., 0.5 mm. of copper and 1 mm. of aluminum; portals of entry eight inches square over each of the three areas and the dose 10 per cent to 15 per cent of a skin erythema dose. Treatment is repeated in three or four weeks, if necessary. Severe general reactions including nausea, vomiting and prostration are not uncommon. Some excellent results have been obtained. It is better to under-treat than to over-treat and probably reactions will be lessened and results better, though somewhat slower, by using smaller doses.

The treatment seems more effective in children and in cases of not too long duration. Persistent cough after pertussis is mentioned as a

favorable condition for treatment. In cases of chronic bronchitis without asthma, the chest only is treated and the dosage is always adjusted to the patient's age, smaller doses than described being used in children.

C. D. ENFIELD, M.D.

*Roentgen-ray Therapy in Bronchial Asthma and Chronic Bronchitis. Isaac Gerber. Jour. Am. Med. Assn., Oct. 3, 1925, p. 1026.*

**Comparison of chemical roentgen dosimeters.**—The author has conducted a series of tests to obtain a comparative scale for the Holzknecht, the Cox-chroma, and the Hampson roentgen radiometer. All these instruments are based on the discoloration of barium platinum cyanide under X-ray exposure. He comes to the conclusion that the Holzknecht radiometer is the most reliable roentgen radiometer.

E. A. POHLE, M.D.

*Comparative Investigation of Several Chemical Roentgen Dosimeters and Test Tablets of Different Origin. J. Palugay. Strahlentherapie, 1925, Vol. 20, 1, p. 153.*

**Necrosis due to radio-active substances.**

—Apparently, radium necrosis occurs only under certain and quite exceptional conditions. It is not the fact of general exposure to radio-active substances or nearness thereto, but, apparently, the direct result of introducing such substances in minute quantities into the mouth through the unsanitary habit of penciling the point of the brush with the lips. As has been said before, every case personally investigated gives an unmistakable history of this habit, while the numerous roentgenograms clearly indicate the consequences to both the roots of the teeth and the jawbone. It may be argued, of course, that other portions of the mouth, particularly the tongue or the lips, should be affected, but the mucous membrane of tissues might not necessarily have the same affinities for radio-active substances as the more sensitive roots of the teeth and possibly the bone of the jaw. As bearing indirectly on such cases, the writer refers to an extremely interesting occurrence brought to his attention by Dr. Davidson of Newark. He had for some time been treating a patient for radium necrosis who did not work at the radium plant nor had he ever been exposed to radio-active substances otherwise than that he had been treated for a tumor of the jaw with radium, as the result of which treatment necrosis developed, and is still developing, being only partly under curative control. The writer has seen the case himself and is convinced that



the condition is as stated, and the direct result of radium exposure. Aside from the foregoing evidence with reference to particular cases, he mentions one additional case of which the details, unfortunately, are not obtainable, but which was brought to his attention by Dr. Andrew McGowan of East Orange, who writes: "Several years ago, a girl came to me with a marked swelling of the gums, looseness of teeth and indications of a necrotic process. She said she used a small brush and shaped it with her mouth before painting, although a small container of water was supplied for the purpose. Unfortunately, she did not return for treatment, so the history of the case ends at that point."

How many cases there are, or may have been, is, of course, a matter of mere conjecture. One dentist, Dr. B. T. Foulkes, writes: "I have any number of patients who have been employed and are still employed in the so-called radium plant of Orange, but I have never had a case of any kind of necrosis among them. I have read so much about this in the newspapers at different times that I have inquired from my patients as to how this material is used, and I find that many put this so-called radium in the mouth. If this is the case, I see no reason why radium necrosis should not develop, provided, of course, the material contains radio-active substances."

At the outset of this investigation, the writer was frequently confronted with the statement that the cases had been diagnosed as phosphorus necrosis; but they could not be that, since phosphorous substances are not used. While the two forms of necrosis unquestionably resemble each other quite closely, it should not be difficult for one thoroughly qualified for the purpose to differentiate the one type from the other. In any event, however, we are dealing with an entirely new occupational affection, demanding the utmost attention on the part of those who are in a position to render the necessary technical assistance, but at the same time it is a safe assumption that if the unsanitary habit of wetting the brush with the lips is done away with, the disease itself will probably tend to disappear, or in any event become extremely rare.

W. W. WASSON, M.D.

*Radium (Mesothorium) Necrosis. Frederick L. Hoffman. Jour. Am. Med. Assn., Sept. 26, 1925, p. 961.*

**Oral administration.** — It is contended by many experts that the oral administration of sodium tetrabromphenolphthalein results in more direct absorption, as the dye is taken up by the portal circulation and carried immediately to the liver and excreted into the gall bladder. Bicarbonate of soda is given in combina-

tion to neutralize the hydrochloric acid of the stomach. Capsules minimize the irritating effect on the stomach and mucosa. It is given preferably after the heaviest meal. The dosage is one-tenth of a grain per kilogram of body weight up to seventy kilograms, above which the dose is reduced, dividing the entire amount into capsules in such a way as to give 0.5 to 1 gr. in each capsule. Two capsules are given at the beginning of the meal, two during the meal, and two after the meal. If more need be given they may be given from one-fourth to one-half an hour after. The bicarbonate of soda is given in capsules after the administration of the dye. Nothing is given the next morning until the films have been taken. Films are taken about noon and later in the afternoon. The intervals may be regarded as twelve, fourteen and eighteen hour periods. Shadows on the forty-eight hour film do not show if the gall bladder is normal. If a shadow of the gall bladder is shown, it indicates that the gall bladder is pathological. At the twelve and fourteen hour periods the gall bladder should be at its greatest size. At the eighteen and twenty-four hour periods the gall bladder is much smaller and more dense.

No severe reactions are shown following the oral administration of the dye. Some slight sensation of nausea and vomiting an hour after the taking of the capsules is frequent, usually present from a half an hour to one hour. There is no appreciable change in the blood pressure. The urine analysis is negative. The dye is given in gelatine capsules hardened by formaldehyde.

#### SUMMARY

Sodium tetrabromphenolphthalein is absorbed by mouth and can be satisfactorily given in sufficient amount to outline the gall bladder. There are the following advantages to the oral administration: (a) less discomfort; (b) no danger of sloughing of the tissues; (c) less time-consuming; (d) safer, and does not affect the systemic circulation, the effect being entirely confined to the portal circulation. One of the disadvantages of this method is that a certain number of patients will not be able to retain the dye. Because of this fact a complete record of the filling and emptying of the gall bladder is not obtained.

The diagnosis will depend upon the same factors as by the intravenous method.

B. C. CUSHWAY, M.D.

*Oral Administration of Sodium Tetrabromphenolphthalein: Preliminary Report. Thomas O. Menees and H. C. Robinson. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 368.*

**X-ray diagnosis of dental lesions.**—The author recites in considerable detail the limitations of X-ray diagnosis of dental lesions, pointing out that too much should not be expected from the X-ray examination of the teeth and jaws, since: first, many structural features cannot be visualized; second, pulp vitality cannot be established; third, inflammatory processes are not recorded; fourth, no information can be gained as to the virulence of infections present; fifth, age and general condition influence bone densities and markings; sixth, the dental history should be taken into account; seventh, X-ray gives no information as to conditions existing underneath gold crowns.

C. D. ENFIELD, M.D.

*Interpretation of Dental Radiographs.* Hugh W. MacMillan. *Cincinnati Jour. Med.*, April, 1924, p. 85.

**Gastric ulcer.**—In the medical management of gastric ulcer, definite indications for surgical intervention may arise. The two emergencies which threaten life in cases not under treatment, do not ordinarily occur in cases under strict management; these are massive hemorrhage and perforation. But other developments may change the clinical picture to a surgical case. In connection with the treatment itself, the two developments which may arise in connection with the treatment are, (1) the failure to neutralize acidity because of excessive night secretion, and (2) alkalosis. In addition to these, the other indications fall under the head of organic defects which are unchanged by treatment, such defects being demonstrable by X-ray. All of these conditions may be detected in the first four weeks of hospital management.

Where X-ray defects fail to improve, they may be of two kinds: (1) cicatricial deformities of healed ulcers, which call for surgery only when they cause obstruction; (2) defects unchanged by ulcer treatment and which, by this, are probably malignant. During the first two weeks of medical management the niche should show definite diminution in size and after a month should no longer be visible in fluoroscopy, otherwise no time should be lost in substituting surgical for medical management.

The author recites several cases, with excellent radiographs to illustrate the points made.

W. W. WATKINS, M.D.

*Surgical Indications Arising during the Medical Management of Gastric Ulcer.* Sara M. Jordan. *Boston Med. and Surg. Jour.*, June 4, 1925, p. 1106.

**Use of roentgen ray in pertussis.**—Results obtained by the roentgen ray in pertussis are marked, but the following measures may be

found useful: Patients receive three routine treatments at forty-eight hour intervals; further treatment is instituted, if necessary, after the expiration of one week's time. Instead of covering the entire chest, endeavor to localize the treatment to areas covering the roots of the lungs, both front and back, the distance diminished from twenty-four to sixteen inches. Thus the total amount of radiation is increased from one-third to nearly two-thirds of the erythema dose in three treatments. No bad effects have been reported as a result of this treatment and the results are better.

**Conclusions.**—(1) Roentgen-ray treatment produces a diminution in the number and severity of paroxysms in over 75 per cent of the cases coming under observation. Vomiting spells are also controlled by this form of treatment. (2) Increased dosage gives better results. (3) Younger patients respond better to treatment. (4) Roentgenographic findings indicate that the good effects resulting from treatment may be associated with the direct effect of the treatment upon the bronchial lymphatic glands.

B. C. CUSHWAY, M.D.

*Further Observations of the Use of the Roentgen Ray in Pertussis.* Ralph D. Leonard. *Am. Jour. Roentgenol. and Rad. Ther.*, May, 1925, p. 420.

**Neutral red in the stomach.**—Contrary to the observations of previous workers, the appearance time of neutral red in the stomach after the intramuscular injection is not sufficiently uniform in various gastric syndromes to be of clinical value.

Quantitative studies show too great variability of excretion to be of diagnostic value.

The presence or absence of excretion of the dye are the only points of clinical significance; i.e., in the differentiation of two types of gastric anacidity. The complete absence of the dye in pernicious anemia in contrast to its excretion, even in small amounts, in carcinoma with anacidity and secondary anemia with anacidity is of definite practical value.

The excretion of neutral red in the human stomach is probably dependent on the presence of hydrochloric acid secretory tissue.

W. W. WASSON, M.D.

*Gastric Excretion of Neutral Red.* Percy B. Davidson, Edouard Willcox, and Cushman D. Haagensen. *Jour. Am. Med. Assn.*, Sept. 12, 1925, p. 794.

**Standardization in "R" units.**—The authors have reported the results of their measurements of deep therapy machines in twenty-seven clinics, showing variations in the S.U.D. used between 285 and 1,120 R. The average

S.U.D. was then suggested at 600 R. Discrepancies between their own and the results of American authors (S.U.D. = 1,400 to 1,800 R) are explained in this paper. The dose of 600 R is based on the energy given by the primary intensity only, while the higher value includes the scattered radiation from the body or water phantom. This additional radiation may increase the primary intensity from 60 to 100 per cent. The depth dose, or the dose effective on the deep-seated lesion, should always be expressed in the future in R units. All publications giving data on therapy and using R units must also state the working conditions; K.V., Ma., Mam., filter, distance, field. It must be clearly indicated whether the S.U.D. is the total intensity or the primary intensity only. The suggestion is made to use as a mean value of the S.U.D. a dose equivalent to 1,200 R (total intensity).

E. A. POHLE, M.D.

*The Measurement of X-ray Doses in an Absolute Unit and the Quantity of X-ray Radiation Required for One Erythema Dose.* L. Grebe and H. Martius. *Strahlentherapie*, 1925, Vol. 20, 1, p. 128.

**Primary tumor of thymus.**—Two cases of primary tumor of the thymus in adults are reported. In both, the characteristic X-ray appearance was a large, circular, flat mass extending outward from the mediastinum and seen, in lateral view, to be applied closely to the anterior chest wall. The mass was non-pulsating, sharply defined and did not invade surrounding organs. In both cases, it was bilaterally symmetrical.

Both cases yielded promptly to X-ray treatment at 200 K.V., with a 5 mm. copper filtration. In one instance there was a local recurrence and what was apparently a metastasis in the tonsil.

Both the X-ray appearance and the prompt response to roentgen therapy are considered characteristic.

C. D. ENFIELD, M.D.

*Roentgen-ray Diagnosis and Treatment of Thymoma.* T. A. Groover, A. C. Christie, E. A. Merritt and F. O. Coe. *Jour. Am. Med. Assn.*, Oct. 10, 1925, p. 1125.

**Unfavorable case for X-ray treatment.**—A child of two and one-half years was given four ordinary X-ray treatments for cervical adenitis, administered over a period of two weeks. Two days after the last one, he had an edematous sloughing of the pharynx, with marked destruction and involvement of the en-

tire cervical region. Death occurred six days after the last X-ray exposure.

"From the autopsy it would appear that the mucous membrane of the upper respiratory tract and tonsils reacted strongly to the X-ray treatment, in addition to the cervical glands." This case would seem to indicate that "there are individual cases which do not react favorably to X-ray treatment."

B. C. CUSHWAY, M.D.

*Case Report: Peculiar Condition of the Upper Respiratory Tract Following X-ray Treatment of Cervical Adenitis.* M. C. Myerson. *The Laryngoscope*, Sept., 1925, p. 703.

**Chronic hypophysitis.**—Fibrosis of the anterior lobe of the hypophysis occurs with moderate frequency in persons past fifty. This condition is apparently due to arteriosclerosis of the vessels of the hypophysis. The character of the lesion is such that it must interfere with the function of the glandular portion of this organ. This suggests one of the reasons for the failure of efforts at rejuvenation that are directed to the restoration of only one gland of internal secretion.

One case of the writers' series appears to be true chronic hypophysitis. In spite of the negative Wassermann test, other findings in the body suggest the possibility of syphilis as its cause.

W. W. WASSON, M.D.

*Pathology of the Hypophysis. III.—Chronic Hypophysitis; Fibrosis.* J. P. Simonds and W. W. Brandes. *Jour. Am. Med. Assn.*, May 9, 1925, p. 1408.

**Arthritis deformans.**—Under the term "arthritis deformans," the authors include all forms of non-specific hypertrophic or atrophic, active or inactive, arthritis encountered in a routine investigation of fifty cases in wards and privately.

In a large proportion of cases the joints were opened and an organism was recovered (L. S. A.), which is identical in every case in its cultural and biochemical features. This organism does not correspond to any organism which has been previously described in association with this or any other disease. In only one case has this organism been recovered from the synovial fluid; in all others, it has been isolated from either the membrane or articular bone.

No lesions have as yet been produced in animals; so far, only the intravenous inoculation of rabbits has been attempted. Nothing constant has been isolated from foci or sepsis, feces, urine, blood, or fasting stomach contents.

The outstanding features in these cases are: the large proportion of cases showing achlorhy-

dria or hypochlorhydria, the practically universal diminution of carbohydrate tolerance, and the relative absence of acidosis, renal or liver defects, or of changes in the basal metabolic rate.

Therapeutically, apart from correction of deformities and removal of focal sepsis, wherever practicable, the only routine treatment employed has consisted in the use of large amounts of 0.4 per cent hydrochloric acid and a carbohydrate-free diet extending over a period of months. The improvement obtained in practically every case, even without the removal of focal sepsis, has consisted of a diminution of pain followed by an increase in the mobility of the joints affected.

SOLOMON FINEMAN, M.D.

*Arthritis Deformans: Observations on its Etiology and Treatment.* L. S. Ashcroft, L. Cunningham, T. P. McMurray, and H. S. Pemberton. *Brit. Med. Jour.*, July 4, 1925, p. 13.

**Antral infections.**—Acute and chronic infections of the maxillary antrum are common in every-day practice. A very small percentage of antral infections are diagnosed early; most remain for years and many are carried to the grave. Part or all of the classical symptoms may be absent; therefore, most antral infections will be found only by hunting for them.

In examining the nasal fossæ, the membranes should be blanched with adrenalin-cocaine spray and search then made for pus issuing from a fossa. If it presents in the middle fossa, it comes from maxillary, ethmoidal or frontal sinuses; transillumination, X-ray and puncture are the chief tools used in differentiating. Pain is very misleading, being usually present in acute cases and absent in chronic ones. If the two antra transilluminate easily and equally, the conclusion that they are normal is justified. If there are differences in density, radiograms should be taken, and trocar puncture used as a final resort.

W. W. WATKINS, M.D.

*The Silent Antrum.* Willard L. Burnap. *Minn. Med.*, April, 1925, p. 203.

**Standardization of X-ray dosage.**—The author, who is connected with the German Bureau of Standards, discusses in this paper (read in London before the International Meeting of Radiologists) the problem of exact dosage of X-ray for therapeutic use. His high pressure air chamber is described and its use for the measuring of the unit one R, equal to one Roentgen, explained. The definition of this unit is: "The absolute unit of the roentgen-ray dose is

given by the quantity of roentgen-ray energy used to produce,—if one c.c. of air (temperature 18° C., 760 mm. mercury pressure) is radiated using all electrons formed in the air and avoiding wall effects,—such a conductivity that the quantity of electricity measured under saturation current is one electrostatic unit."

The next step is to express the so-called biologic unit in this absolute unit. No final solution has been found; it is suggested, however, to work for the timebeing with the equation one H.E.D. (S.U.D.) = 1,200 R. (This unit is entirely different from the French R as given by Solomon.)

E. A. POHLE, M.D.

*The Standardization of X-ray Dosage in Germany.* H. Behnken. *Strahlentherapie*, 1925, Vol. 20, 1, p. 115.

**Gastric carcinoma.**—A review of 2,000 gastric complaints in this clinic has shown the upper abdominal organic lesions responsible for these complaints to be about in the following ratio: Gastric ulcer 1, gastric cancer 2, duodenal ulcer 6, gall-bladder disease 12. Eusterman agrees that this ratio is about correct, except the incidence of cancer is higher at the Mayo Clinic, due probably to the large number of hopeless cancer cases who go there as a last resort.

The early symptoms of cancer usually are not considered important by the patient; he is a little off in eating, food does not taste right, he is tired, has a little indigestion, etc. Such patients should never be given a simple remedy and turned loose without a thorough physical and X-ray examination.

In the 58 patients with gastric cancer, a presumptive diagnosis was made by the roentgenologist and clinician on 57 patients. The radiologist cannot differentiate between lues and gastric carcinoma as a rule, nor can he differentiate uniformly simple ulcer from malignant degeneration of ulcer. The expert radiologist will recognize 98 per cent of carcinomatous stomachs as showing organic pathology, and the clinician must supplement these findings by other means.

This exact radiologic diagnosis is highly technical, requires large experience, has many pitfalls to the occasional operator, and requires combined fluoroscopic and radiographic procedures. A positive diagnosis of carcinoma of the stomach is made with fair frequency by unskilled radiologists, when such a lesion is not present.

W. W. WATKINS, M.D.

*Gastric Carcinoma.* John Minor Blackford. *Northwest Med.*, June, 1925, p. 280.



**Cancer mortality statistics.**—The author analyzes the returns on which his deductions are based, and arrives at the following conclusions: 1. There has been a pronounced increase in the observed death rate from cancer in persons forty years and over in that part of the United States known as the "ten original registration states." 2. Part of this increase (about 30 per cent) is due to greater precision and accuracy in filling out death returns. 3. The remainder, however, is an actual increase in mortality, resulting in a death rate between 25 and 30 per cent higher than it was twenty-one years ago.

C. D. ENFIELD, M.D.

**Cancer Mortality in the Ten Original Registration States: Trend for the Period 1900-1920.** J. W. Schereschewsky. *Jour. Am. Med. Assn.*, Oct. 17, 1925, p. 1175.

**Tumors.**—The authors suggest a standardized exposure of high voltage X-rays as a "therapeutic test" in the differential diagnosis of mediastinal tumors. After the diagnosis of mediastinal tumor is made the patient receives a treatment over the chest with these factors: 200 K.V., 1 mm. Cu. and 1 mm. Al. filtration, 90 to 100 per cent skin unit dose. (The authors fail to state what they mean by "skin unit" in this connection.) Films of the chest are then made at intervals of ten days, three weeks, six weeks, three months, and thereafter every three months. They state that lymphosarcoma, thymoma, pseudo-leukemia, lymphatic leukemia, and simple lymphoma will have disappeared in from four to ten days. Tumors caused by Hodgkin's disease, hyperplastic tuberculosis (Sternberg) and endothelioma recede to half their original size in ten days and disappear in six weeks. Benign tumors (lipoma, chondroma, fibroma, adenoma, myoma; neuroma, dermoids, etc.) and pseudotumors show no change. It is suggested that this method may prove curative as well as diagnostic in a number of instances and may often obviate unnecessary and dangerous thoracic surgery.

C. D. ENFIELD, M.D.

**Deep Roentgen-ray Exposure as an Aid in the Differential Diagnosis of Mediastinal Tumors.** William A. Evans and Traian Leucutia. *Jour. Am. Med. Assn.*, Oct. 17, 1925, p. 1215.

**Protection.**—The protection given by a tube stand enclosing the Coolidge tube in a lead cylinder was investigated by ionometric and photographic tests. These show that the space on both sides of the treated body contains the maximum of scattered radiation. It is recommended to use a lead shield of three millimeters' thick-

ness on the side which faces the technician. The table should also be leaded to avoid its penetration by X-rays. The fluoroscopic detector may be used in practice (eyes well adapted!) to control the tight closure of the protective device. It is an open question, however, if radiation, the presence of which is proved by this test, really causes an appreciable exposure of the personnel. (See A. Mutscheller, *American Journal of Roentgenology*, 1925.)

E. A. POHLE, M.D.

**X-ray Protection and Tolerance Dose.** R. Glocker and E. Kaupp. *Strahlentherapie*, 1925, Vol. 20, 1, p. 144.

**Arthritis deformans.**—X-ray treatment of cases with arthritis deformans is recommended. The joints, with the surrounding tissue, are exposed over an anterior and posterior field of 20 × 20 centimeters, once a week, using 7 H. per field through 0.36 Cu. plus 2.2 Al. The paper is based on 400 cases. No changes are seen in the roentgenograms; the result is symptomatic only and perhaps due to chemical changes.

E. A. POHLE, M.D.

**X-ray Therapy of Arthritis Deformans.** K. Staunig. *Strahlentherapie*, 1925, Vol. 20, 1, p. 113.

**Light treatment.**—Sunlight and open air treatments of many chronic inflammatory diseases have been used very widely during recent years by such men as Bernhard, Rollier, Hill, Gauvain and Pugh.

The fact that sunlight can not be depended upon as a constant radiant source in most localities has stimulated a search for a substitute.

Finsen originated a method of local treatment for lupus by means of light—both natural and artificial. His results were promising, and treatment by phototherapy has gradually evolved to take an important place in present-day therapeutics. The general routine of treatment consists in exposing the entire body to the light in gradually increasing doses. The progress with light treatment is naturally slow, since it is the chronic inflammatory diseases that are being treated. It is important that careful observations should be made, as any series of cases might give valuable information on the general subject.

B. C. CUSHWAY, M.D.

**Observations on Some of the Principles of Artificial Sun Treatment.** Albert Eidinow. *British Jour. Tuberc.*, July, 1925, p. 113.

**The ureters.**—The rôle of the ureter is assuming more and more importance as a contributing factor in clinical manifestations. It is



now generally recognized that strictures from causes other than tuberculosis and lithiasis, are frequently found in the ureters, if properly sought. It is obvious, when one recalls the anatomy of the ureters, that roentgen examination will be futile without the injection of some opaque material. Roentgenology is the procedure of choice as a preliminary to stereoscopic examination. The examination is made following the introduction of opaque catheters. This method is especially useful in differentiating small shadows. Both catheters are introduced from a distance of twenty to thirty centimeters; then during the injection the catheters are withdrawn to a distance of five to ten centimeters from the bladder. Valuable findings, such as stricture, kinks, diverticula, multiple ureters, fistulae and tumors may be obtained.

As evidence of the importance of roentgenology in contributing to the diagnosis, a case is reported in which the injection method was used. The films showed the lower portion of the ureter to be ragged in outline, with an irregular course denoting a well advanced infiltration process. Tuberculosis was diagnosed and, upon operation, this was found to be correct.

More and more is the exclusion value of the roentgenogram being acknowledged. A negative ureteral pyelographic examination is being utilized in diagnosis of obscure abdominal and pelvic conditions. The course of the ureters and the pathology most commonly found at the various positions along their course may be classified as follows: The upper ureter is frequently found afflicted with stricture or the presence of calculi. The middle portion is frequently found to be the position of inflammatory changes, calculi and external compression effects from tumors, etc. The lower portion is most frequently found afflicted with the presence of calculi, inflammatory extensions from pelvic floor, and tuberculosis. In the most distal portion of the ureter, tuberculosis is frequently found.

The value of the roentgenogram in diagnosis of ureteral variation from the normal is very definite. The roentgenogram is being recognized by clinicians as a valuable aid and is being relied upon more universally as time goes on.

B. C. CUSHWAY, M.D.

*Ureteral Variations, with Associated Kidney Changes.* Douglas J. Roberts. *Am. Jour. Roentgenol. and Rad. Ther.*, April, 1925, p. 353.

**X-ray misinterpretations.**—This author calls attention to some of the ridiculous and inexcusable errors into which physicians and surgeons are frequently led when they attempt to have consultations in radiologic interpretation

with "X-ray photographers" who are not medically trained. The mistakes which seem too ridiculous to be true, when viewed by *bona fide* radiologists, are the common lot of doctors who cheapen their profession by using laymen as consultants in medical matters; such mistakes as diagnosing the epiphysis as a fracture, overlooking dislocations about the wrist, diagnosing spasms and peristaltic waves as organic disease in the gastro-intestinal tract, calcified lymph nodes, phleboliths and fecaliths as stones, the normal fibrosis of the lungs as pathological, the foramina and antral shadows about the teeth as abscesses, etc.

No specialty in medicine requires a more comprehensive knowledge of medicine and a higher degree of specialization than does radiology, and the attempt on the part of the physician or surgeon to secure "cheap" work will lead to disaster.

W. W. WATKINS, M.D.

*Some Misinterpretations of X-ray Plates and Fluoroscopic Screens.* Carl E. Koenig. *Northwest Med.*, March, 1925, p. 136.

**Cholecystography.**—A review of the work done according to the technic of Cole and Graham. The authors have had no reactions in more than a dozen cases, eight of which are reported in some detail, in all of which the operative findings were in accord with the X-ray findings.

W. W. WATKINS, M.D.

*Cholecystography and the Diagnosis of Chronic Gall-bladder Disease.* Kenelm Winslow and C. Melgard. *Northwest Med.*, March, 1925, p. 124.

**Acute mastoiditis.**—The X-ray findings in acute mastoiditis should always be considered as one link in the chain of evidence and not the last word. Frequently the X-ray examination would indicate an operation to be imperative when the clinical findings are not conclusive. The opposite is also frequently found to be true.

A negative X-ray report, like a negative Wassermann, may occur when subsequent events prove them to be in error. Repeated examinations should be made to determine the breaking down of the cell walls.

The roentgenologist should be a man of experience and wide training as well as good judgment in order to interpret the X-ray findings in the light of the history and clinical findings in the case.

B. C. CUSHWAY, M.D.

*X-ray of Mastoiditis.* S. G. Dabney. *The Laryngoscope*, Sept., 1925, p. 675.

**Pertussis.** — Most of the writer's patients were treated with the following technic: 4 ma., 2 mm. Al. filter, 7-inch gap, distance 14 inches, time 5 min., except in the case of young infants, when first treatment was given for a shorter period—2½ to 3 minutes. Treatment is usually given with patient in recumbent position, lying on his back. Recently the writer has used longer exposures—8 min., with 5 ma., 2 mm. filter, 7-inch gap, 14-inch distance. Thyroid should always be protected.

Justification for treatment is based on the knowledge of the effect of the rays in reducing hyperplastic lymph nodes.

Conclusions are briefly as follows: 1. Treatments should not be given before the paroxysmal stage of the disease. 2. In cases of secondary pneumonia there was general improvement following X-ray. 3. Excessive exposure of young children to X-ray is dangerous. 4. Results, both immediate and remote, of roentgen therapy should be given further study before recommending method for general use. 5. Negative results were 25 per cent in summer and fall cases, and 47 per cent in winter cases.

CHARLES H. DEWITT, M.D.

*Treatment of Pertussis by Roentgen Ray.* Julius H. Hess. *Ill. Med. Jour.*, Sept., 1925, p. 215.

**Adenoids and tonsils.**—Clinical and pathological studies show that roentgen-ray treatment, when given in sufficient dosage, causes a shrinking of the lymphoid tissue of the tonsils and, to a lesser extent, the adenoids. The bacterial examination shows that the X-rays have no effect on the local sepsis of the adenoids and tonsils.

Many children are frequently troubled with colds, sore throat and have difficulty in breathing as a result of hypertrophy of the tonsils and adenoids. Many of these symptoms subside at the time of puberty.

Roentgen radiation is utilized in such cases in order to shrink the lymphoid tissue, allowing the affected child better breathing space. On the other hand, when there is direct evidence of local sepsis in the adenoids and tonsils, operative procedure is definitely indicated. Local sepsis can readily be determined by the history of acute tonsillitis, suppurative otitis media, tuberculosis, cervical adenitis, arthritis, etc. Inspection of the tonsils visually with the aid of a good light will also aid in the determination of the process of focal infection and a selection of cases may thus be made.

B. C. CUSHWAY, M.D.

*Roentgen Ray Treatment of Tonsils and Adenoids.* P. B. MacCready. *Am. Jour. Roentgenol. and Rad. Ther.*, May, 1925, p. 424.

**X-ray therapy of gastric ulcers.**—In Holzknecht's clinic X-ray therapy of gastric and duodenal ulcers has been done since 1916. In this paper the author reports seven cases of ulcer ventriculi, six of which healed under X-ray treatments using medium dose (one-fourth to one-third S.U.D.) over the stomach; an anterior and posterior field was given. The effect was controlled by observing the disappearance of the niche (Haudeck). The course of a typical case is described.

E. A. POHLE, M.D.

*Ulcer Therapy of "Niche" Ulcers in the Stomach.* R. Lenk. *Strahlentherapie*, 1925, Vol. 20, 1, p. 103.

**Cholecystography.**—Successful cholecystograms can be made by oral administration of sodium tetraiodophenolphthalein and sodium tetrabromophenolphthalein. Doubtful results of cholecystography following oral administration should at present be confirmed by intravenous injection. Phenoltetraiodophthalein also produces good cholecystograms.

W. W. WASSON, M.D.

*Cholecystography: Oral Administration of Sodium Tetraiodophenolphthalein.* Everts A. Graham, Warren H. Cole, Sherwood Moore, and Glover H. Copher. *Jour. Am. Med. Assn.*, Sept. 26, 1925, p. 953.

**Sero-diagnosis of malignant disease.**—Murray has recently brought forward some evidence that a neoplastic reaction evoked at one site in an animal confers some resistance to such change at another site and he suggests that there is some systemic constitutional change. If such be the case then it is not improbable that the medium of distribution of the locally produced change is the blood. On these grounds a serological reaction would appear to be practicable.

In experiments carried out by the author, it was found that extracts of cancer tissue used as antigen in complement fixation experiments often showed marked anticomplementary properties. It seemed possible that a method, in the nature of a colloidal flocculation reaction, which dispenses with the hemolytic system, might prove of value. On this basis a method using human breast carcinoma tissue as antigen was finally worked out, which has proved, in general, satisfactory.

In a series of 500 cases, comprising both malignant and non-malignant conditions, 75 per cent of correct results were obtained.

In 239 cases of malignant disease, 170 positive flocculations were obtained (71 per cent correct).

In 261 controls, comprising healthy individuals, cases of non-malignant neoplasms, medical

and surgical conditions, 204 gave a negative result (78 per cent correct).

Healthy individuals gave a uniformly negative reaction, except in one instance.

Non-malignant tumors usually gave a negative reaction.

In the absence of malignant disease, flocculations do not in the majority of cases occur with syphilitic conditions, but a control Wassermann reaction or Sigma reaction is advisable.

With acute febrile conditions, for example, tuberculosis or sepsis, positive flocculations may occur.

The writer concludes, therefore, that, excluding certain conditions, the reaction is of value in the diagnosis of malignant disease.

SOLOMON FINEMAN, M.D.

*A New Flocculation Reaction for the Serodiagnosis of Malignant Disease.* H. J. B. Fry. *Brit. Med. Jour.*, July 4, 1925, p. 4.

**Gastric cancer.**—The author presents statistics relative to the frequency of gastric cancer and enumerates the acute and chronic conditions with which it may be confused. He evaluates symptoms, such as pain, hemorrhage, vomiting, etc., and laboratory tests, as gastric analysis and analysis of the stool for blood, and concludes that roentgen examination is the most important factor in the diagnosis. He attributes a possible accuracy to this measure of 98 per cent in a positive direction and 97 per cent in a negative way. He describes with considerable detail a technic of examination, including two barium meals. He classifies the roentgen signs of gastric cancer as primary and secondary without, however, emphasizing to any great extent the ragged, irregular contour of the characteristic filling defect. He mentions the use of antispasmodics in re-examination.

C. D. ENFIELD, M.D.

*The Diagnosis of Gastric Carcinoma.* J. H. P. Gauss. *Cincinnati Jour. Med.*, October, 1925, p. 405.

**Peptic ulcer.**—The author mentions the fact that several German workers have for some years been treating peptic ulcer with X-rays with sufficient success to encourage them to further efforts. Specifically, he cites a report by Matorie, of Vienna, giving 77 per cent of clinical cures. He, himself, reports twenty-six cases, treated within the preceding ten months, with encouraging relief from symptoms and cessation of occult blood in the stool in most of the cases. The technic involves the use of 60 per cent skin erythema dose, 205 K.V., 1 mm. of zinc, 1 mm. of aluminum, 5/10 mm. of celluloid filtration.

Following the first treatment, the patient is put upon a liberal ulcer diet with alkalis for six to ten weeks. The author admits that the improvement may be due to the diet or the alkalis or both, rather than to the X-ray treatment and that the elapsed time is too short to warrant any conclusions as to permanent relief.

C. D. ENFIELD, M.D.

*X-ray Treatment of Stomach and Duodenal Ulcer.* Otto Thuss. *Cincinnati Jour. Med.*, May, 1924, p. 141.

**Examination for cancer.**—The writer suggests as a part of the educational propaganda to laymen, that a thorough annual examination for cancer should be made in every person, beginning with his fortieth year. Perhaps this may appear utopian, but one must remember that propaganda through the press has practically no limit in its possibilities.

W. W. WASSON, M.D.

*Point of View of the Internist in the Study of Cancer.* John Dudley Dunham. *Jour. Am. Med. Assn.*, Jan. 3, 1925, p. 8.

**Fluctuation of primary voltage and roentgen energy.**—The observation of a marked difference in the radiation of patients (skin erythema) in the Institute for Cancer Research in Amsterdam led the authors to investigate thoroughly the electrical factors governing the output of X-ray apparatus. They tried to answer the following questions: (1) Is the primary potential (220 V.a.c.) constant? (2) Is the output of the apparatus constant if the primary voltage is constant? (3) Does the X-ray output remain unchanged if the primary fluctuations are corrected by regulating the apparatus (kilovoltmeters, milliamperemeters)? (4) Is there any advantage in using kenetrons instead of rectifying disks; what influence have condensers?

A recording voltmeter was connected with the primary current for eight days; the line voltage fluctuated between a minimum of 205 V. and a maximum of 225 V.: i.e., —7 per cent to +2.5 per cent of the usual potential of 220 volts. The roentgen radiation was then measured with a Dessauer-Back electroscope while changing the primary voltage from 205 to 220 volts, at the same time keeping the K.V. meter and the Ma. meter constant. No appreciable change in the quality or quantity of radiation could be detected. The same measurements were done with two and four kenetrons in the circuit instead of the mechanical rectifiers; the results were the same. To get the exact potential on the tube,

spectograms were taken with the Seemann spectograph, which also showed the distribution of the intensities of the various wave lengths in the spectrum. Photometric curves are given in the paper and show that the condenser and kenetron are superior to the mechanical rectifier. A potential drop off of 5.5 K.V. through the rectifier is also omitted. The authors come to the conclusion that the observed variations in the skin reactions are not due to an inconstancy of the apparatus, but to a different individual susceptibility to radiation, because their measurements show that fluctuation in the line from 205 to 220 volts did not change the character of the radiation if the K.V. meter and Ma. meter are kept constant.

E. A. POHLE, M.D.

*Does the X-ray Energy Change during Line Fluctuations when the K.V. Meter and Ma. Meter are Kept Constant? D. den Hoed and L. J. Koopman. Strahlentherapie, 1925, Vol. 20, 1, p. 162.*

**Rectal fistulas in the tuberculous.** — The author draws the following conclusions:

1. We are not justified in making the diagnosis of tuberculous fistula except by definite microscopic picture or in cases in which the lesion has the typical appearance described elsewhere in this paper.

2. Considering all cases of fistula *in ano*, it is doubtful whether more than 2 or 3 per cent are tuberculous in character.

3. Tuberculosis is very rarely primary in fistula *in ano*. If it occurs at all it is not more than a small fraction of 1 per cent.

4. Probably 15 per cent of fistulas occurring in tuberculous patients are tuberculous; 0.33 per cent of tuberculous patients also have tuberculous fistulas. (These figures are based on a too insignificant number of cases to justify a positive statement.)

5. In view of the ease with which the tubercle bacillus affects the mucous membrane of the bowel, it would seem possible that in some cases—at least in tuberculous persons, in whom the fistulas appear to be a simple inflammatory process—the original lesion in the bowel wall is due to the tubercle bacillus. However, this is purely a matter of opinion and has not been proved. In any event, it has but little bearing on the prognosis or treatment of the fistula.

6. It is probable that tuberculosis as such has a tendency toward the formation of rectal fistula, but that this tendency is not as great as is generally supposed. The general condition of the patient is also a decided factor.

7. It would seem that the formation of rectal fistulas in persons who are underweight is un-

doubtedly a definite warning of the presence of pulmonary tuberculosis or of a tendency toward its development. These persons are entitled to a most scrutinizing general examination, which, even if negative, should be repeated periodically.

W. W. WASSON, M.D.

*The Relationship of Tuberculosis to Fistula in Ano. W. A. Fansler. Jour. Am. Med. Assn., August 29, 1925, p. 671.*

**Whooping cough.** — In two parallel series of twenty-two cases of whooping cough, selected mainly by alternation, one group treated by roentgen ray and the other by antipyrin, the disease ran an average longer course, fewer patients ceased whooping in the early weeks, and more patients were still whooping in the late weeks in the irradiated series than in the controls. The present study would appear to justify the conclusion that radiotherapy is without true beneficial effect in pertussis. Our method of treatment does not appear to differ in essentials from that ordinarily used. It is possible, and perhaps likely, that occasional temporary exacerbations or inhibitions of attacks may occur shortly after roentgen-ray treatment, but these should probably be ascribed to psychic disturbance. Effects of greater extent or duration, such as have been previously reported from roentgen ray as from other modes of treatment (excepting sedative drugs), are in all probability apparent rather than real and represent normal fluctuations in the course of a highly variable disease.

W. W. WASSON, M.D.

*Does Roentgen Ray Modify the Course of Whooping Cough? Harold K. Faber and Homer P. Struble. Jour. Am. Med. Assn., Sept. 12, 1925, p. 815.*

**Sodium chlorid in intestinal obstruction.** — These results all lead to the conclusion that sodium chlorid has some protective value against the toxemia developed in high intestinal tract obstruction. Distilled water does not prolong life or return the blood chemistry to normal as does sodium chlorid.

The sodium chlorid seems to be the essential factor in the treatment of the toxemia, and its estimation in the blood serves as an indicator of the degree of toxemia. It appears from experiments that there is always, to some extent, a depletion of the chlorids before protein destruction begins, with a rise in the non-protein elements of the blood. Just what the danger point is in the fall of the chlorids, we have not definitely determined: it probably varies in different individuals. We feel that a blood chlorid of 400 in intestinal obstruction should be a sig-



nal for the generous administration of sodium chlorid. Judging from our experimental studies and observations of patients, it is essential to administer sodium chlorid in acute intestinal obstruction before operation as well as after. The quantity of the salt necessary to return the blood chemical changes to normal can be determined only by blood studies. A diminution in chlorids is easily determined by their precipitation in the urine with silver nitrate solution and comparing with the normal. We have made a rough estimate that 1 gm. of sodium chlorid per kilogram of body weight should be given as an initial dose in very toxic patients. This is best given subcutaneously in 1 or 2 per cent solution or intravenously in 5 per cent solution.

Too few clinical observations have been made to form the basis of any conclusions concerning mortality rates. However, we feel confident that surgical risks may be lessened by the pre-operative use of plenty of salt, and lives saved by its careful administration until the toxemia of intestinal obstruction has disappeared.

W. W. WASSON, M.D.

*Reducing the Surgical Risk in Some Gastrointestinal Conditions.* Thomas G. Orr and Russell L. Haden. *Jour. Am. Med. Assn.*, Sept. 12, 1925, p. 813.

**Gall-bladder examinations.**—The duodenobiliary drainage following a single stimulation with magnesium sulphate solution produces a reduction in size and alteration in shape of the gall-bladder shadow when visualized by the Graham method. Plates taken at intervals up to twenty-four hours after injection of the dye, but without drainage, show no parallel diminution in size or alteration in shape of the shadow.

Since non-surgical biliary drainage reduces the size and alters the shape of the gall bladder, we are led to conclude that drainage of the gall bladder does take place.

W. W. WASSON, M.D.

*Observations of the Visualized Gall Bladder by Graham Method, with Reference to the Effect of Non-surgical Biliary Drainage: Preliminary Report.* Daniel N. Silverman and Leon J. Menville. *Jour. Am. Med. Assn.*, Feb. 7, 1925, p. 416.

**Metastatic bone carcinoma.**—There are many inconsistencies in the course of bone metastasis. The insidious onset, lack of disability, latent periods, and fluctuating symptoms make it hard for physicians to accept the X-ray diagnosis. The roentgen examination shows two very different types of invasion which are sometimes hard to differentiate from other lesions.

The usual locations of metastases from the breast are: ribs, spine, femur, ilium, skull, and humerus. It is not unusual to find all these bones involved if the patient lives long enough. The lesion from the prostate reaches first the pelvis, lumbar vertebrae and the femur, then, occasionally, the scapula and clavicle. A metastasis in the scapula is usually prostatic in origin. If the primary tumor is rapidly growing and with little stroma, the metastasis will be a rapidly destructive lesion and the bone will melt away before it. In the long bones the growth starts in the marrow and expands in all directions, completely destroying the cortex and the cancellous tissue. In the vertebrae the destruction is irregular. There is no new bone production, the process being purely destructive. If the original tumor be slow-growing or has a large stroma content, the metastasis will show very little destruction and be accompanied by a reactive sclerosis. There is no cortical or periosteal thickening, but a diffuse, irregular sclerosis. This osteoplastic type is early and extensive in carcinoma of the prostate, the chalky appearance of the spine and sacrum being almost pathognomonic of prostatic origin. However, it occurs in 14 per cent of breast metastasis cases and may occur in any slow-growing carcinoma.

The disease must be differentiated from round-cell sarcoma, Paget's disease, hypertrophic spondylitis, and syphilis. The clinical course of bone metastasis bears no relation to the severity or progress of the disease. Frequently a spontaneous fracture is the first evidence of metastasis, and extensive bone lesions may be present before the primary tumor is recognized. A most striking feature is the fluctuation of symptoms independent of the progress of the disease. The author reports a patient who was examined at the hospital, and found to have osteoplastic metastasis of the pelvis, sacrum, and lumbar vertebrae. He was helpless, bedridden, and suffering intensely. One year later he walked into the office, claiming that he was free from pain and desiring to check the diagnosis. The examination showed complete destruction of the wings of the ilia and an extension of the metastasis.

F. B. SHELDON, M.D.

*Metastatic Bone Carcinoma.* Lyell Cary Kinney. *Calif. and Western Medicine*, June, 1925, p. 734.

**Radium in carcinoma of the cervix.**—Heymann, the co-worker of G. Forssell, presents in this paper his experience and full technic with the radium treatment of carcinoma of the cervix. Both men were in this country last year as guests of medical societies and some of this



material has been previously published in English. (*See Jour. Obst. and Gynec. Brit. Emp., July, 1924, p. 31.*)

It seems, however, worth while, considering the importance of their work, to repeat some of their conclusions, based on cases treated from 1914 to 1921. Two points may be mentioned: First, in Forssell's Institute, "The Radiumhemmet," in Stockholm, all cases of carcinoma of the cervix are, as a rule, treated with radium only; X-rays in medium doses are used in recurrences or metastases of the parametrium. All patients are referred by surgeons and gynecologists. Until 1920, inoperable cases only were received, but since the excellent results presented at that time most of the leading physicians have discontinued operating on cervical cancer, so that from 1921 on about 36.5 per

cent of the total number of cases referred have been operable ones.

From the chapter on technic, we will quote that radium is used intra-cervically and intra-uterinely; a filter of three to four millimeters of lead is used, and the total dose in the uterus given in three fractional doses, varies between 2,220 and 2,640 mgm.-el. hours; the vaginal dose given in two fractional doses is about 4,000 mgm.-el. hours. Any kind of operation, including cauterization, before radium treatment is contra-indicated.

E. A. POHLE, M.D.

*Technic and Results of the Treatment of Carcinoma of the Cervix in Radiumhemmet, Stockholm.* H. V. James Heymann. *Strahlentherapie*, 1925, Vol. 20, 1, p. 34.

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